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ELECTRIC MOTORS.

THE electrical journals of New York, in the most recent numbers which have reached England, publish a letter from Mr. F. J. Sprague, whose electric railway system and motors have been from time to time noticed in our columns. Mr. Sprague appears to have been irritated by certain references to his work, partly our own, but mainly—or so we gather—contained in the communications from Professors Silvanus Thompson, Ayrton and Perry, and Mr. Mordey. As, however, Mr. Sprague does not particularise or in any way indicate to what he objects in these "attacks" (as he calls them), we are a little at a loss to know to what extent we ourselves are included in his rather sweeping but vague complaint; or in what proportion the blame is to be subdivided between the gentlemen alluded to. The gist of Mr. Sprague's complaint is that, to some extent, the originality of his work has been questioned. Now, as far as we are concerned, the only passages which can have given displeasure to Mr. Sprague are some in which we objected to his claim to being the discoverer of the principle that under varying loads or speeds self-regulation can be obtained by an inverse varying of the strength of the field. This was alluded to in an American contemporary as being Mr. Sprague's "main principle." Our readers will, we are sure, fully agree with us that we were right in pointing out that this principle is at any rate as old as the differential winding of Professors Ayrton and Perry. But instead of meeting the statements which have been put forward —a task for which he states he has not time at present —Mr. Sprague makes a proposal which appears to have not even a remote bearing on the statements of which he complains. His proposal may be seen in our other columns, and his challenge we leave to be dealt with by those to whom it is addressed, merely remarking that in none of the five divisions of this extraordinary proposal is there any reference to the only point on which, as far as we know, any criticism of Mr. Sprague's work has appeared in our columns, namely, the methods and laws of self-regulation. We are sure that the eminent jurors, to whom are to be presented the motors proposed to be constructed under Mr. Sprague's conditions, will appreciate the generosity as well as the delicate sense of humour which prompts the gift.

Electric Lighting in Gold Mines.—At the recent meeting of the Alturas Gold Mines Company, Mr. B. Anthony said it was proposed to light the mines with the electric light, as in the case of Montana. Incandescent lamps would do away with the danger from fire, and there would be a saving of about 40 per cent. compared with the cost of oil.

ELECTROLYTIC TREATMENT OF ARGENTIFEROUS LEAD AND COPPER ORES.

M. EUG. MARCHESE, whose researches on the electrolytic treatment of ores have been repeatedly mentioned in this publication, has recently introduced an improvement in the electrolytic separation of copper from the lead and the silver of ores and other products of the treatment of argentiferous materials by using as anodes metallic sulphides prepared with the substances themselves to be treated. The transformation of the sulphuret of iron of the anodes into ferrous sulphate (copperas) adds the electromotive force generated by this oxidation to that developed by the galvanic source. The improvement consists in causing the solution obtained by the lixivation of the roasted ores to circulate continually between the electrolytic cells and the digesting vessels in which the electrolyte becomes charged anew with metal. This arrangement decidedly diminishes the polarisation.

The following is a brief description of the process :— The ores containing the copper and the argentiferous lead are generally accompanied by earthy gangues more or less soluble in acids. In this case the ores are fused in the crude state as they come from the mine, without having to undergo any roasting in the furnaces commonly used.

This operation produces a kind of regulus in which are concentrated the copper, the lead, the silver, the iron, and the sulphur of the ores, combined with the metals in the state of sulphurets.

The proportion of copper and iron in this regulus is determined by chemical analysis. When once the mean proportions for a given ore are known a part of the regulus is cast directly into plates destined to form anodes; the rest of the contents of the furnace is granulated or simply run upon the ground, and broken up and then roasted.

The relative proportions of the regulus run into plates and granulated is so regulated that we have in the plates serving as anodes a quantity of iron representing two equivalents of that metal for three equivalents of copper existing.

The object of the roasting is to convert the copper into oxides, which on subsequent treatment with dilute sulphuric acid furnish a solution of sulphate of copper containing sulphate of iron, and which serves as an electrolyte.

The essentially novel point in this process consists in the action of the electrolyte upon these anodes, the iron of the plates being reddened by the solution of copper; this action generates an electromotive force which reinforces that furnished by the external voltaic source, so that a much feebler generating machine is sufficient than is required if the solution of sulphate of copper had to be decomposed electrolytically between two conductive plates not attackable by the bath.

To repair the plates serving for anodes it is necessary to re-cast the regulus obtained directly from the ore which contains along with copper a certain quantity of argentiferous lead, and it is run into moulds of dimensions ascertained to be suitable. These moulds are placed upright, and in each is placed a band or wire of copper reaching up above the mould, so that after casting a part of the wire or the band is held fast in the solidified mass whilst one extremity remains free, so that each plate may be connected with the principal conductor.

The anodes, to the number of 15 or 20, are arranged perpendicularly in suitable troughs, they rest upon two ribs occupying the bottom of the apparatus, so as to leave a space of about 15—20 centimetres between the lower side and the bottom of the plates. Between each anode is arranged a plate of electrolytic copper forming the cathode. On the two sides of the apparatus are fixed cross-pieces of wood fitted with teeth in the form of a rake, intended to keep the plates separate.

The sulphuric acid needed to act on the roasted ore is obtained in lead chambers from the sulphurous gas

evolved in roasting the ore. The quantity of acid is regulated so as to preserve the electrolyte slightly acid.

An important condition of this process is that the electrolyte circulates continually from the electrolysis troughs to the tanks in which lies the roasted ore. When the current passes the copper of the anodes is transferred to the cathodes, whilst the iron, which is likewise attacked, is converted into sulphate. The electromotive force evolved in these reactions is employed for the decomposition of the sulphate of copper, and for depositing copper upon the cathodes. It follows that the liquor becomes continually poorer in sulphate of copper, and it is in order to restore its original strength that it is run back into the solution-tanks in contact with the roasted ore.

The mud deposited at the bottom of the bath contains free sulphur, oxides and sulphurets of lead, iron, &c. The silver contained in the ore is likewise found there in a concentrated form.

When the mud is still too rich in copper to be treated directly for argentiferous lead it is submitted to a new roasting, and is returned, along with fresh materials, to the solution tanks.—*Revue Industrielle.*

ON THE VARIABLE PERIOD OF CURRENTS WHEN THE CIRCUIT CONTAINS AN ELECTRO-MAGNET.

NOTE BY M. LEDUC, PRESENTED BY M. LIPPMANN.

Formulæ.—We admit, in order to represent the variable period of a current in a circuit deprived of iron, the formula

$$i = \mathrm{I}\left(1 - e^{-\frac{\mathrm{R}}{\mathrm{L}}t}\right), \qquad (1)$$

in which i represents the intensity of the current at the time, t, I its final intensity, and L the coefficient of self-induction of this circuit.

Experiment has shown us that this formula is no longer applicable when the circuit contains an electro-magnet, *even when the magnetisation is in proportion to the intensity of the current.*

Generally speaking, if we represent by ϕ the total flow of force passing through the circuit at a given moment, by E the electromotive force of the battery ($\mathrm{E} = \mathrm{I}\,\mathrm{R}$), and if we disregard :—

(1). The delay in the magnetisation ;

(2). The energy transformed into heat by the currents induced in the iron ;

(3). The remanent or permanent magnetism, we easily get the following differential equation :

$$(\mathrm{E} - \mathrm{R}\,i)\,d\,t = d\,\phi. \qquad (2)$$

Let us consider, specially, two simple cases realised by the electro-magnet of Faraday, when the polar surfaces are at a distance of less than 0·01 metres. Experiment shows that the value, F, of the magnetic field in the middle may be represented, at least from 1 to about 100, by the formula

$$\mathrm{F} = m_1\,i, \qquad (3)$$

for values of i below 0·2 or 0·3 C. G. S. (2 ampères or 3 ampéres), and by M. Frœlich's formula

$$\mathrm{F} = \frac{m\,i}{1 + \mu\,i}, \qquad (4)$$

for values above 0·3.

Let us first examine this last case and suppose that the magnetic field is established at the beginning in accordance with this law (4).

If we designate by S the total surface that must be attributed to the circuit enclosing a uniform flow of force equal to F in order that the total flow may have the same value, ϕ ($\mathrm{S}\,\mathrm{F} = \Phi$), equation 2 may be written :

$$(\mathrm{E} - \mathrm{R}\,i)\,d\,t = \mathrm{S}\,m\,d\left(\frac{i}{1 + \mu\,i}\right)$$

or

$$\frac{1}{\mathrm{S}\,m}\,d\,t = \frac{d\,i}{(\mathrm{E} - \mathrm{R}\,i)\,(1 + \mu\,i)^2}. \qquad (5)$$

This equation must be integrated between 0 and t for the first term, limits which correspond to 0 and i for the second term, and to $-$ I and $+\,i$ if we consider the reversing of the current by means of a suitable commutator.

In the first place we get

$$t = \mathrm{A}\left\{[n + \mu\,\mathrm{I}\,(n-1)] + \mathrm{B}\,\frac{i}{1 + \mu\,i}\right. \qquad (6)$$

and, in the second case,

$$t = \mathrm{A}\left\{\frac{2}{1 - \mu\,\mathrm{I}}[n + \mu\,\mathrm{I}\,(n-1)] + \mathrm{B}'\,\frac{\mathrm{I} + i}{1 + \mu\,i}\right. \qquad (7)$$

If we take

$$\frac{1}{n} = 1 - \frac{i}{\mathrm{I}},$$

we get

$$\mathrm{A} = \frac{\mathrm{S}\,m}{\mathrm{R}\,(1 + \mu\,\mathrm{I})^2}, \qquad \mathrm{B} = \frac{\mathrm{S}\,m\,\mu}{\mathrm{R}\,(1 + \mu\,\mathrm{I})},$$

$$\mathrm{B}' = \frac{\mathrm{S}\,\mu\,m^2}{\mathrm{R}\,(1 - \mu^2\,\mathrm{I}^2)}.$$

When formula (3) is applicable, these last become

$$t = \frac{\mathrm{S}\,m}{\mathrm{R}}\,\}\,n, \qquad (8)$$

$$t = \frac{\mathrm{S}\,m}{\mathrm{R}}\,\}\,2\,n. \qquad (9)$$

The formulæ (1) and (8) are equivalent. The formula (9) is deduced from them by admitting that when the current is reversed, the extra currents, called the breaking and closing currents, are superposed and have at each moment the same intensity.

Experiments.—The relations that we have just established were not verified satisfactorily in the experiments that I made with a strong Faraday electro-magnet. When the polar surfaces of this apparatus are at a distance of ·5 centimetres, and the current lower than 2 ampères, the magnetic force, F, is pretty accurately represented by formula 3, in which we get $m = 26{,}300$. The surface, S, is difficult to estimate. I think it may be admitted that the value $\mathrm{S} = 96{,}000$ cq. is correct within about 5 per cent.

In an experiment in which $\mathrm{I} = 0{\cdot}17$ and $\mathrm{R} = 2{\cdot}4 \times 10^9$ the variable period might be represented by

$$t = 1{\cdot}05\ \mathrm{L}\ n = 2{\cdot}42\ \text{log. vulg. } n. \qquad (10)$$

Now, experiment shows that the current is established at the beginning much more quickly than is indicated by this formula and afterwards more slowly, so that the current only really attains $\frac{9{\cdot}9}{10{\cdot}0}$ of its final intensity at the end of 8″·8, when the formula (10) gives for the corresponding value of t ($n = 100$),

$$t_1 = 4''{\cdot}84.$$

The curve calculated and the curve observed cross one another when $\frac{i}{\mathrm{I}} = 0{\cdot}75$, *i.e.* $n = 4$, a value for which we get

$$t = 1''{\cdot}46.$$

This difference between calculation and experiment may be explained by a delay in the magnetisation ; this delay may be due to the induced currents which are generated in the mass of iron, the action of which at each instant interferes with that of the current, i. Now, if the value of the field is at each moment below that which corresponds to the current of intensity, i, when stationary, the battery can only effect at the beginning a result below that which we have supposed it to produce, and the current is consequently established more quickly than is indicated by formula

(10); but soon after, on the contrary, the battery must accomplish more work than we have estimated, for $\frac{d\phi}{dt}$ goes on diminishing, so that the current undergoes a delay that becomes more and more considerable.

I propose to repeat these comparative experiments by means of an apparatus, the constants of which may be determined exactly, and to construct the curves which represent the values of i^2 as considered in connection with the time. The areas comprised between each of the two curves (calculated and observed) and the axes of the co-ordinates should be equal if the energy transformed into heat by the induced currents in the cores be disregarded.

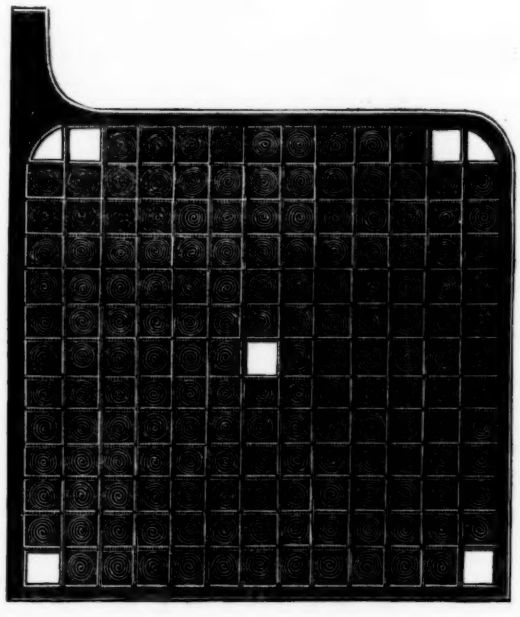
I have made several experiments on the establishment and reversal of the current in the circuit of Faraday's electro-magnet. I shall confine myself to indicating in the following table the time, *t*, required in order that the current may regain, after being reversed, $\frac{99}{100}$ of its initial and final intensity; N designates the number of Bunsen elements which serve to produce a current with intensity, I; D is the distance between the polar surfaces.

		N	1.	2.	4.	8.
		I	0·087	0·172	0·31	0·52
			s	s		
D =	0		29	13·53	7·43	4·50
	0·25 cm.		„	15·30	„	„
	0·5		„	11·08	9·32	4·93
	1		„	7·74	7·70	5·30
	2		„	5·87	5·56	4·88
	4		„	„	4·10	4·00
	40		„	„	2·80	„

—*Comptes Rendus.*

ELIESON'S SECONDARY BATTERIES.

THE illustration shows a plate of the Elieson secondary battery, such as is in use in connection with the electric locomotive devised by that gentleman for use on the North Metropolitan Tramway, and to which we have at various times referred in our columns.



The perforations in the lead grid are filled with spirals of lead ribbon rolled up with asbestos paper, to separate the convolutions one from another.

This constitutes the entire element, there being no paste used in either the positive or negative plates.

In the process of forming, the spirals get very firmly fixed in the grid, and, as we have before pointed out, the plates may be subjected to extraordinarily rough usage, such as being allowed to drop from a height of 6 or 8 feet to the floor, without suffering any deterioration. We cannot yet give the electrical data of these cells, although we hope to do so in the immediate future; but one would expect them to compare favourably with others of the Planté type in the market.

ELECTRIC TRAMWAY CONDUITS.

THE conduit which Mr. M. Holroyd Smith devised for the reception of the conducting mains on his Blackpool line is familiar to the readers of the REVIEW, and the illustrations given below, which we have reproduced from the New York *Electrical World*, are interesting as forming a means of comparison between the systems of Mr. Smith in this country and of Bentley-Knight in America. A few weeks ago we had occasion to remark that our transatlantic cousins were fond of *systems*, but, that so far as our observations went, we often found it hard to distinguish between them, the differences consisting not, as the initiated would suppose, in the application of various distinct principles, but more in the variation of designs.

FIG. 1.

The Bentley-Knight conduit in which the conductors are carried is said to form a most important and interesting part of the system. Fig. 1 shows an enlarged view of the conduit, in the construction of which the iron yokes are first set up and lined, being placed from three

FIG. 3.

to four feet apart, and between the ties which support the rails. The continuous concrete gutter is then formed, the material being rammed around and between the yokes with the aid of wooden forms fitting the yokes. The insulating pins are then placed in the sockets cast in the yokes, and the conductors, in lengths

of 30 feet, are set against the pins and firmly keyed to them. The electrical connections between the lengths of conductor are then made, and the slot irons set on the yokes, their stay bolts dropped into the exterior lugs of the yoke, and the slot irons and yokes firmly bolted together, leaving a surface opening of only $\frac{5}{8}$ of an inch. The two main conductors consist of channel-iron connected by expansion joints and lined with a continuous strip of copper of sufficient size to carry the current with but small loss of energy. These conductors are fastened to the side walls of the conduit on insulators of vulcanised wood dipped in white lead. The insulators are strongly set in sockets in the cast iron supporting yokes. Neither the traffic rails nor the conduit structure form any part of the electrical circuit. To provide for switching a movable tongue is pivotted at the point of branching, so as to rest on the top of the conduit and to be readily set to close either of the branch slots and direct the contact plough into the other. A corresponding conductor tongue within the conduit is moved at the same time. This is shown in fig. 2 which represents one form of yoke, track and pavement complete, fig. 3 showing the iron work in isometric projection. The bottom of the yoke extends only 1 foot 4 inches below the level of the pavement.

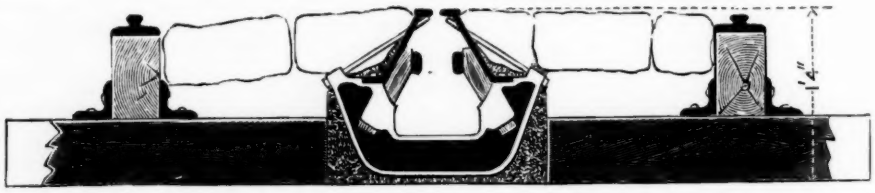


FIG. 2.

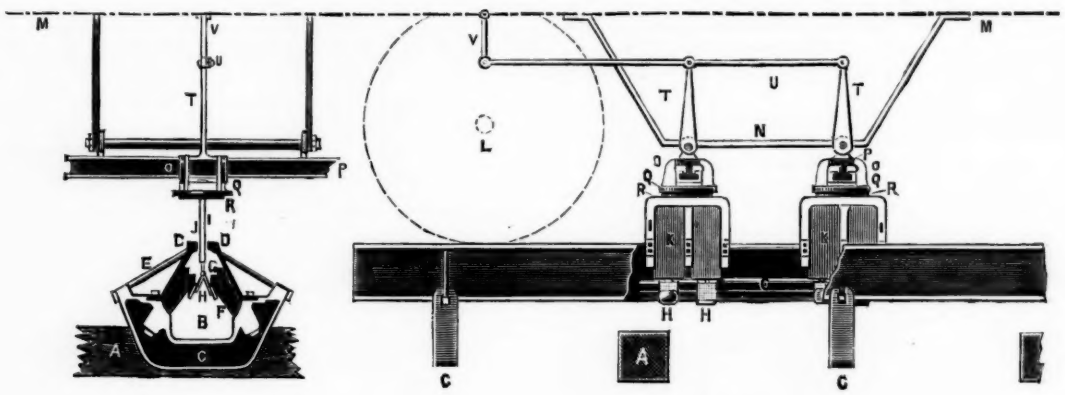


FIG. 4. FIG. 5.

The method of making electrical connection between the motor and the conductors in the conduit—an important point—has been well worked out, and is clearly shown in figs. 4 and 5. For this purpose a contact plough is employed which consists of a flat frame, I, hung from the car by transverse guides, on which it is free to slide the whole width of the car and extending thence down through the slot of the conduit. It is provided with a swivel joint, Q, so as to adjust itself to all inequalities of road or conduit. This frame carries two flat steel insulated conductor cores, K, to the lower ends of which are attached by a spring hinge small contact shoes, H, of chilled cast iron, that slide along in contact with the two main conductors, C. At the upper ends are flexible connections leading to the motor. This plow can be inserted or withdrawn through the slot at will, the spring hinge allowing the contact shoes to straighten out into line with the conductor cores when the plow is pulled upward and the shoes strike the insulating lining with which the slot irons are provided. By no accident, therefore, can anything be left behind in the conduit to obstruct succeeding cars. The plough guides are hung on transverse axes, and are held in a vertical position by a spring catch that gives way when the plough meets an irresistible obstruction, and hence the plough is automatically thrown completely out of the conduit without injury, being also immediately replaceable. The contact shoes will stand weeks of wear and cost next to nothing. The frame of the plough has wearing guards, I, of hardened steel wherever it can touch the edge of the conduit slot, and these are also readily renewed. Two ploughs are used on each contact for the sake of absolute reliability, and to prevent flashing at the contact. The electrical details of the system have been reduced to the utmost simplicity, so that the handling of the cars can be trusted to the most inexperienced. The motor on the car is of a modified Gramme type and wound in series, the regulation being effected by interposing resistances which are under easy control of the driver. It is proposed to carry a potential of 500 volts on the conductors, and, according to grade and load, the current required will vary from 3 to 30 ampères. An ingenious device brought to the aid of the driver is the arrangement by which, when the hand brakes are applied, the motor is automatically cut out of the circuit, so that only a single operation is required to stop the car.

As the cost of the Fulton Street line is evidently an important factor, it may not prove uninteresting to give it in this connection. The road is to be a double track, the greatest grade being 1 in 12; 12,660 feet conduit (extra heavy), at $4, $50,640; 20 motor trucks complete, at $1,200, $24,000; six 50 H.P. dynamos, at $2,500, $15,000; steam plant complete, $20,000; foundation, $2,000; engineering, $2,500—$114,140.

Dead Wire of the Armatures of Dynamos.—With reference to the article of Prof. W. A. Anthony on the above, reprinted in our last week's isssue, our readers will remember that we dealt very fully with the question in our leader of August 13th, 1886. The conclusions arrived at by Prof. Anthony are precisely the same as those we expressed in the article referred to, and in some paragraphs the language in which they are uttered is almost identical.

ELECTRICITY AND INSURANCE.*

By HENRY HINE.

THE attitude of the fire insurance interests toward the electric light is a matter of first importance to its users, and consequently to those engaged in its introduction. The question of its relative safety to other illuminants has been fully discussed, and rules, designed to insure its proper equipment formulated and enforced, but we have not reached that point of cordial co-operation and mutual understanding which is necessary to the best interests of all concerned. Insurance men are apt to be suspicious of the electric light companies, and they in turn are apt to grumble at the insurance companies, and the public seeing this, gets wrong ideas as to the whole matter.

Both parties are to blame for this condition of affairs; therefore, that our subject may be discussed in the proper spirit, let us take a very hasty glance at the history of our past relations, confess to our respective sins, and resolve in future to act with mutual confidence and in a way to relieve the public entirely from its present uncertainty on the main question, namely, is the electric light safer than other methods of artificial illumination?

When the electric light was first introduced, the electric companies unhesitatingly asserted and advertised the fact that a perfectly safe light was at last discovered. These assertions, in the main honestly made because of ignorance, were soon proved false by the occurrence of fires directly traceable to electric circuits, and, led on by the daily papers, whose reporters found unusual opportunities for displaying their genius in dealing with this mysterious fire-scattering and death-dealing agent, and inspired with a feeling of awe, which was a natural result of profound ignorance of the subject, the public became extremely apprehensive.

In the meantime the insurance companies had awakened to the importance of taking action in regard to the new light, and when they began their investigations so little was really known about the dangers to be avoided, and how best to avoid them, that necessarily misunderstandings occurred and suspicions were aroused on both sides.

Electric light men accused insurance men of meddling in matters they knew nothing of, of greatly exaggerating existing dangers, and of creating imaginary ones, and the insurance people accused them of doing poor work in order to save in cost of construction. A good deal was felt on both sides that was never expressed, and I well remember when the inspection of an electric light plant was looked upon by both inspector and inspected as a game in which they were antagonists, each thoroughly believing that the other was trying to get the best of him.

As, however, the insurance companies realised more and more the advantages of the electric light, and as the electric companies better understood their business, both began to appreciate, little by little, that their interests were identical, until we have now reached a point where it is not a question of establishing a friendship already existing of the utmost mutual benefit.

The insurance companies should not be blamed for their conservative course in the past, and when we consider the phenomenal development of electric lighting, its wide-spread use and the tremendous forces which are so freely handled in its generation and distribution, too much praise cannot be given the electric light companies that so little damage has been inflicted on life and property.

To-day I believe that all the insurance associations admit that the electric is as safe as other lights, and some go even further and do not hesitate to say that it is much safer when properly installed.

Now this is all that the electric light companies claim. We not only freely admit but take pains to publish the fact that great danger would attend imperfect and careless equipment, but we emphatically assert that such work has not been the rule, and that as installed to-day by the reputable companies, an electric light system, whether arc or incandescent, isolated or central station, continuous, pulsating or alternating current, contains fewer elements of danger than lighting by gas or oil.

In this connection it will not be out of place to allude to the recent fatal fire at the Temple Theatre in Philadelphia, Pa. An attempt was made to fasten this fire on the electric light, and the proceedings before the coroner's jury have undoubtedly created wrong impressions in the minds of many and done injuries to the electric light interests which were never intended by those conducting these proceedings. The electric light companies should be, and I believe are, in full sympathy with Inspector McDevitt in doing his utmost to ascertain whether or not this plant was properly equipped and operated, but, in pointing out by experiment what might occur under certain conditions, he was not careful enough to state that these dangers could be easily avoided. He simply proved what we all admit, that wires and lamps may be elements of danger. With everything his own way he had considerable difficulty in producing fire. How hard would he have had to try with gas? How long could he have kept a handkerchief wrapped around a gas flame?

The neglect to consider this question of safety relatively is what we complain of, and it undoubtedly works much injustice against the electric light. Again, the burning of the Rhode Island Electric Light Company's Station at Providence, week before last, illustrates how apt the electric light is to be blamed for things of which it is entirely innocent. The fire was at once attributed, by the press and public generally, to the electric current, but investigation has proved beyond question that it was caused by coal gas.

While on this topic I wish to allude to another case of injustice against the electric light companies—unintentional no doubt by its author, but none the less harmful—and at the same time to correct some misconceptions which the public may have as to the attitude of this club. I allude to the paper read here by Dr. Benjamin at our last meeting but one, and, though at our last meeting Mr. Beane clearly showed by statistics how uncalled for were the extreme views expressed in this paper, the fires above alluded to, which have occurred since then, the unfortunate accident which resulted in the death of a line man in this city, the fact that this club has been placed in a false position, and that Dr. Benjamin's paper is used by those opposed to the electric light interests to uphold false views and create wrong impressions, constitute my apology for again alluding to this subject.

Any opinion on matters of this kind, emanating from this club, has peculiar significance and weight, and right here must go on record that we believe the electric light to be safer than other lights, and that we cannot countenance an opinion that the electric light companies are criminally careless and narrow minded in their business methods. It will not do for this club to, in the least, alarm the already foolishly sensitive public on this subject. While we all agree with Dr. Benjamin that we must take a broad and disinterested view, and not allow our utterances to be in any way misleading to the public, he has been over cautious, as the general tone of his paper is unjustified, and his insinuations against the electric light companies uncalled for, and not warranted by facts. It is not right that the literature of this club should be used against the interests of a large body of its members, if such literature distorts facts or creates wrong impressions.

What the electric light people desire is more light on this whole subject. We want the insurance men and the public to be educated in these matters, feeling confident that, as they become more familiar with them, their apprehensions will disappear. At the same time we ourselves are anxious to learn, and are learn-

* Paper read before the Electric Club, of New York, February 3rd, 1887.

ing every day, how to do better work, and are only too happy to encourage any discussion, carried on in the right spirit, which will lead to a more thorough knowledge of the necessities for proper installation and throw light on doubtful points.

The question of the insurance of electric light stations has been so fully discussed of late that it needs none of our attention to-night, more especially as it has been taken up by "manufacturers' mutual companies" in whose hands it is sure to receive intelligent treatment; but there is crying need for a uniform system of rules governing the installation of plants, to be adopted by all the insurance associations throughout the country, which shall be alike acceptable to the electric and insurance interests, and insure a uniform standard of excellence of equipment. The convenience and welfare of the public demand this, and our mutual interests can be well served by agreeing at once on the necessity for such rules, and then taking steps towards their formation and adoption. Our identity of interest should insure careful and thorough consideration of this subject, for as to what these rules shall be there is a chance for considerable difference of opinion.

It is not within the province of this paper to suggest a set of rules, and I should not presume to do so if it were. The work of compiling them should be done by thoroughly competent, and above all, practical persons representing both interests, and they should only be decided on after mature consideration. These persons should constitute regularly organised committees, and proper provision be made for the final adoption and adhesion to the rules, so formed, by all the electric and insurance companies in the country.

Most, if not all, of the various sets of rules now in force are based on those of the New York Board of Fire Underwriters. It is significant that these rules, the first to be made, and since only slightly modified, have been so closely adhered to and proved so efficient. I attribute this largely to the fact that they possess the great merit of being short and few in number. Is it not a mistake to try and cover every detail of construction by those rules? Insist on the primary requirements for safety, but leave details to those engaged in the business who must be responsible for the proper operation of plants. Possibly our insurance friends are not aware that, in every plant installed, precautions are adopted not required by any rule save the necessity of making it practical and efficient in operation, and the enforcement of a complication of detail rules would often prevent the adoption of the safest method, as it would be absolutely impossible to provide for all cases.

Again, the more the rules enter into details the more difficult is it to obtain thorough inspection. Would not a few simple rules and a well organised and intelligent system of inspection be much more efficient than many and complex rules and the loose inspection which would necessarily result in such a case?

The insurance companies and the public have in the necessities for the successful and economical operation of plants a surer safeguard than in any system of rules which could be devised.

In looking over the various rules now in force a few points have occurred to me which may be of some little value, and I offer them for what they are worth.

Proper conductivity and insulation, and the use of efficient safeguards in case of accident, are the three essential points to cover, and I believe they can be comprehensively covered by a few simple rules.

On the question of conductivity the present rules differ widely. One requires that the main conductor must equal in weight per foot the wire constituting the circuit of the armature of the dynamo. Another, that all wires used in connecting lamps and other appliances with the generator must have a conductivity at least equal to No. 6 wire "American gauge," and this with no modifying clause as to the system used. Still another, that a wire must be large enough to carry fifty per cent. more current than will ever be required for the lights it supplies, and another that a wire warm to the touch in comparison with another wire is liable to become a source of danger and should be replaced by a larger wire. Not one of these is comprehensive, and I would suggest that a simple and efficient rule would be one which prescribes a certain sectional area of wire per ampère of current. Another point upon which the rules differ greatly is the distance which must be maintained between positive and negative wires. If the plant is properly installed in other respects, it is a question, whether in most systems, it is not safer to have all wires very close together. Some of the rules now in force require that a plant entire must show a certain insulation resistance. The idea of the rule is good, as it is a check on the whole work, but is it fair to require the same insulation resistance in a plant where the electromotive force used is 100 volts as is required where it is 1,000 volts? Then again the greater length of wire in an installation the less is its total insulation resistance, though, for a given unit of length, it may measure as high as an equal length in a smaller installation whose total resistance is much greater. It would therefore be unfair to require in large installations the same insulation resistance as in small ones. Would it not be well to avoid this unfairness by requiring a certain insulation resistance per thousand feet of circuit? Differences also exist in the present rules as to the use of fusible strips. These should be required either in both poles all through a system, or only in one, but all in the same pole, and there should be a standard metal or alloy used for the strips, and their capacity be regulated by specifying a certain sectional area per ampère of current. Still again the rules do not all require soldered joints. I believe that there can be no argument against, and a great many in favour of, soldering all joints between wires, no matter how small or where located. The installation of street circuits, their entrance into buildings, &c., seems to be well covered by the New York rules, as the few fires and accidents here attest.

Underground circuits and alternating currents will of course now claim a share of attention, but no new principles are involved in either which need cause fear among the insurance people that before rules can be made damage may occur. If the insurance people will take hold of this matter in the same spirit which exists to day among the electric light men, no difficulty will be experienced in formulating an efficient set of rules satisfactory to both and advantageous to the public.

A well organised system of inspection and the employment of intelligent inspectors will do more to insure proper work than rules, more especially because improvements are being made from time to time which necessitate changes in details and in wiring systems. Where there are two ways equally safe, of doing the same thing, permit either. Let us aim at general results rather than at minute details. Let us act in such a way as to leave no doubt as to our confidence in each other.

This suggests one other point which I feel I must mention, and that is it seems to me the time has come when insurance men should universally encourage the introduction of the electric light by offering reduced rates where it is used. Some of the associations have recently adopted resolutions to this effect, and this good example should be followed without delay. The general introduction of the electric light will benefit the insurance companies more than any single interest in the country, and we ask for whole-hearted support and assistance in return.

In view of the near approach of the semi-annual meeting of the National Electric Light Association at Philadelphia, it seems to me the occasion is a good one for this club to use its influence in accomplishing this much desired reform, and I suggest that through a properly appointed officer or committee we present this matter to that association and urge immediate action thereon.

The Dangers of Gas Lighting.—An explosion occurred recently at the gas works of Lynn, Mass., and that city was left in darkness. Damage to the extent of $1,000 was caused, and two men were injured.

ELECTRIC LIGHTING AT BRIGHTON.

THE vexed question of the best mode of lighting the handsome Pavilion at Brighton was again to the fore at last week's meeting of the Town Council, when the committee's recommendations as to the continued use of electricity were further considered. Alderman Hallett explained that he desired, as representing the committee, to obtain the assent of the corporation to the proposal that the existing electric wires should be put into a proper state of repair at a cost of £412 15s., and that a competent electrician should be appointed to carry out the work, which would occupy some two or three months, and might best be disposed of between Easter and the summer season. It had been said that the electric light did not emit sufficient heat, but complaints had always been received that the Pavilion rooms were chilly, and whatever warmth they obtained from the gas was only got at the expense of the very important consideration of health. To obviate the cold a heating apparatus was required. The speaker proceeded to refute an assertion which had appeared in print to the effect that he had exaggerated the price of gas, and pointed out that the Pavilion was rendered more attractive by electricity than ever it could be by gas. He moved that the wires at present fixed should be put into a proper state of repair; that an electrician should be appointed at a salary of £2 a week; and that the arrangement with Mr. Volk should not be renewed. The resolution having been seconded by Alderman Lamb, Councillor Carpenter expressed a hope that great hesitation would be displayed in passing such a motion, because they had had considerable information which showed that great danger attended the electric light, both to life and property. By selling the electrical apparatus they might raise sufficient money to purchase good gas fittings. Councillor Hall contended that gas had proved eminently expensive, and had, moreover, injured the decorations. The electric light was now largely used in Brighton, and if it did not pay, how long did they think that it would be kept on at the Orleans Club and at the Railway Station? The electric light was in the end cheaper and better than gas. Several speakers opposed the motion, and although in favour of electricity, Councillor Bennett declined to support it until some comprehensive scheme was submitted for warming the Pavilion. Alderman Lamb pointed out that many had declined to hire the Pavilion rooms because they could not give them the electric light. Alderman Sendall submitted that it would be more wise to spend £1,000 on the perfecting of the electric light than £1,500 on improving gas. Eventually an amendment, proposed by Councillor Turton, and referring the matter back to the committee on the ground that a more comprehensive report dealing with both heating and lighting, was carried by three votes after a formal division.

CENTRAL STATION LIGHTING.

WE have on several recent occasions made mention of the Kensington Court electric light installation, which has been carried out to supply the residents on the estate which was formerly covered by the house and grounds of Baron Grant, with the electric light. The undertaking was proposed some three years ago, but it was only by virtue of a recent agreement between the estate owners and a small private company that it has become possible. The difficulties and expense involved in laying the conductors have been materially reduced by the company having obtained permission to utilise a subway which passes under all the roadways on the estate and in which are placed the hydraulic mains for the supply of power to each house. Our excellent contemporary *Industries*, to whom we are indebted for particulars of this interesting scheme, states that the use of this subway frees the company from the expense and delay of obtaining Parliamentary sanction, and places it beyond the reach of the restrictions imposed by the Act of 1882.

The company placed the whole of the contracts for the supply of the material, and the working and maintenance of the same, in the hands of Messrs. R. E. Crompton & Co., who have undertaken to construct all buildings, supply and fix all necessary machinery, fittings, &c., and to produce the required amount of electricity at a fixed annual cost for a period of three years, and at the same time to repair and maintain the plant in thorough working order. The installation is, in fact, a central station for the supply of electricity in the same sense as those in America, but on a smaller scale. The engineering difficulties have been of an exceptional nature. In the first place, it was necessary to design and lay out all the plant and buildings in such a manner as would admit of their sixfold expansion later on, without in any way interfering with the conditions of working that might then obtain. The engine shed is situated in close proximity to High Street, Kensington, and negotiations are already well advanced for lighting some of the principal shops in that street from the present shed. The subway passes round the entire estate, and affords every facility for getting the branch leads into the houses. It is 6 feet high and 3 feet wide, clear inside dimensions, and the main cables are carried throughout it on L shaped wooden troughs attached to the walls. The subway follows approximately the middle line of the streets, and entrance is obtained to it at a point only a few yards from the Electric Light Company's boundary. The plant at present *in situ* consists of a Willan's three-cylinder compound engine, which is coupled direct to a Crompton dynamo, having double field-magnets placed horizontally. This combined set is not, however, intended to permanently do the work, but will be replaced by a Willan's single-crank triple expansion engine, in combination with a Crompton dynamo, provided with vertical inverted single magnets. The power of the present engine and dynamo, and that of the proposed plant is, however, the same, viz., 250 ampères at 140 volts, when running at 500 revolutions per minute. The boiler was specially made by Messrs. Marshall for the work of driving the triple expansion engine with steam of 160 lbs. pressure. It is made of steel, the plates forming the barrel being half an inch thick. The draught is taken downward by an underground flue, and arranged in the same way as was adopted with the boilers at the installation at Victoria Railway Station, which have given every satisfaction. The boiler now in place is capable of developing 60 H.P. to 70 H.P. The exhaust from the engine is led into a tank or condensing chamber before it reaches the chimney, and from this chamber, as a hot well, the feed water is drawn by one or other of two small Worthington pumps. A duplicate boiler and combined engine and dynamo will be fixed as soon as the demand for current has sufficiently increased. The switch board is of a somewhat novel character, and serves for the connection of dynamo, mains, main battery, and regulating cells. As a rule, the dynamo and accumulators are used in parallel. The current enters and leaves the regulating cells by the same contact; in other words, in place of there being a multiple charging and discharging switch, there is only one multiple switch, which serves for both purposes. This switch, which is fixed on a slate base, has nine contacts, so as to give nine degrees of regulation of the light. When the dynamo and accumulators are working together, the lights are parallel with either 41, 42, or 43 cells, according to the amount of charge in the cells, and current required; while, when the dynamo is out of circuit, the lights are worked off 50, 51, 52, or 53 cells, according to the degree of charge in the battery, and the current required. The contacts consist of a series of rings, cut on one side, and through which is forced in turn a circular brush, fixed to, and in electrical connection with, a horizontal screwed spindle, which serves to produce the movement. The screw is rotated by a hand wheel with a heavy rim, and the amount of sparking when the circular brush-

like contact passes in and out of the rings is extremely small. In addition to the multiple switch just described, there are the usual two-way switches, for sending the currents through the various measuring instruments, or breaking any of the circuits at will. The accumulators are stored, tier upon tier, in racks, which arrangement has been chosen in order to economise space, and lessen the risk of damage to the cells. The latter are of a novel type, not hitherto described in any technical journals. They are really pure Planté accumulators; but the plates, instead of being plain lead, are sawn out of ingots which are cast porous by the patented process of Mr. J. C. Howell, of Llanelly. Each cell contains 35 plates, 8 inches by 8 inches. These plates, when fully formed, are said to be capable of yielding 5 ampère hours per pound of lead, at which rate each cell has about 600 ampère hours total capacity. A remarkable feature claimed by Mr. Crompton for these cells, is their great power of rapid discharge without damage. The cells at Kensington Court are intended to be discharged, should any emergency arise, at the rate of 300 ampères, which rate would empty them in two hours; but Mr. Crompton maintains that even in case of a serious break down, when the whole of the work would fall on the accumulators, they could furnish a steady current of 500 or 600 ampères for three-quarters of an hour or more, and herein lies the novelty of the Kensington Court arrangements. We have an accumulator put in, not only as a fly wheel to the whole system, and to give the great advantage of supplying current throughout the day, and the small hours of the night when the engines are not running, but to act as an actual reserve capable of maintaining the whole of the lights for a short period, if an accident should occur during the busiest hours of lighting. The capacity of the whole plant, as now put down, is determined by the possible rate of the accumulator discharge. Generally, the dynamo will start charging the accumulators a few hours before dusk. For a short time after lighting hours commence, the dynamo alone will be able to supply sufficient current; but later on the demand will gain on the dynamo, and a certain portion of the discharge will be from the accumulators. At eleven o'clock at night the engine will be stopped, and the accumulators will then alone supply the demand for the remainder of the night. We may say, at the present moment, that Messrs. Crompton consider that they can depend on supplying a demand of 400 ampères, and this is sufficient to supply about 1,000 of the lights that are now being fixed in the houses and shops. As soon as the demand exceeds 400 ampères, the accumulators will be supplemented by another set inserted in parallel; and, as occasion arises, another engine and dynamo, and then another boiler, and so on, will be added. On the ground which has already been taken up by the company, there is ample room for enlarging the present plant of engines, dynamos, and accumulators to ten times its present capacity, or to a capacity of 10,000 lights; but it is intended to take up additional space for accumulators at distant points in the surrounding districts, so that eventually the present station will only contain engines and boilers and sufficient accumulators for the reserve and home district supply. A large portion of the engines and dynamos will then be used for charging the distant accumulator stations in turn. In this way the total capacity of the station as a generating centre may be increased up to 20,000 or even 30,000 lights. The lamps used have been specially designed for the work by the Edison-Swan Company, and are worked at a higher efficiency than usual. They give 13 C.P. for 36 watts, or 2·75 watts per candle; 13 candles is found the most convenient power for private houses and shops, and is preferable to the larger units of 16, 18, or 20 candles hitherto employed. The consumers will be charged by meters, those used being made by Ferranti and Cauderay. Mr. Crompton has been testing both these meters for very extended periods, and has satisfied himself that they are sufficiently accurate for the purpose. The meter is fixed in a conspicuous position in the basement passage of the house, and the consumer is supplied with a card on which the readings of meters are entered in exactly the same manner as obtains with the ordinary gas supply, and so far the consumers seem to be extremely well satisfied with it.

A CHALLENGE FROM THE OTHER SIDE.

MR. FRANK J. SPRAGUE has written the following letter to our American contemporaries, and we feel sure that its reproduction will be a source of innocent amusement, if nothing else, to our readers:—

"An English paper, the TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW, has seen fit during the last three or four months to make several attacks upon myself. These attacks have not only been made by the editor of the paper, under, it seems, necessarily a gross misapprehension of the facts, but a number of communications have been published, which have been copied by your own and other papers, from Professor Silvanus Thompson, Messrs. Ayrton and Perry, and Mr. William Mordey, in which they, too, have joined the hunt, and raised the cry against the originality of my work.

"When the numerous duties which occupy my time will permit I will answer, in such detail as I think is necessary, these assaults. Meanwhile I have to make the following proposition, which, if these gentlemen believe what they say, they will either accept, or else apologise for the statements which they have made.

"I propose that Mr. Thompson, or Mr. Ayrton, or Mr. Perry, or Mr. Mordey—any one or all of them—and myself, shall build two electric motors, which shall be submitted, one to John Hopkinson, of Westminster, London, and the other to Henry Rowland, of Johns Hopkins University, Baltimore, the machines to be duplicates. I mention these gentlemen because they are recognised as men of the highest scientific attainments, and as absolutely beyond and above all question as to their character and the reliability of any test or report which they may make. The conditions for building these motors shall be as follows:—

"1st. They shall be from working models and designs dating back not less than five (5) years, as sworn to by not less than three (3) witnesses.

"2nd. There shall be no change whatsoever in the machines from the time the working drawings leave the table until the machines are completed.

"3rd. Such machines shall be completed within eight (8) weeks from the time they leave the drawing board, or by May 1st.

"4th. These machines are to be tested, first, for the maximum horse-power for a given weight; and, second, they shall be tested for efficiency with any given weight per horse-power, such weight not to exceed forty (40) pounds.

"5th. The motors to be of not less than 10 horse-power capacity for 10 hours' continuous run.

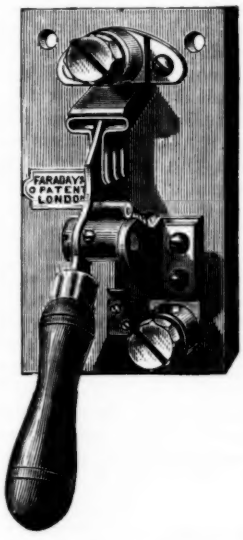
"These machines to be given to the gentlemen who make the tests, or to any institute which they may designate, the entire expenses of the tests to be paid for by the competitors in equal proportions.

"I shall not now enter into any discussion whatsoever of the question that has been raised by these gentlemen; I wish them to answer explicitly and without equivocation this challenge to build machines on models of 1881, without any change whatsoever from that date to this."

Croydon and its Gas Works.—The result of the polling with respect to the acquisition by the Borough of Croydon of the local gas works, and the promotion of a Bill in Parliament allowing the purchase, has been a very decided negative. Chiefly on the ground that the electric light was coming more generally into use the recent town's meeting declared emphatically against the scheme. A poll was demanded and was taken last week with the following result:—For the purchase, 2,997; against, 8,027; majority against, 5,030.

SWITCHES AND LAMP HOLDERS.

MESSRS. FARADAY AND SON have recently brought out an improved pattern of their "Pointsman" switch. This switch has now been in use for three years, and its merits have had public recognition from Mr. Preece and other electrical authorities. The patentees claim that it is the most readily manipulated of any switch in the market, and that the spring jam contact gives the maximum conducting surface with the minimum of weight in metal.



Messrs. Agnew's Galleries in Old Bond street have just been fitted throughout with double pole switches on this principle under the direction of the Phœnix Fire Office.

The annexed illustration shows the new "Sydenham" lamp holder brought out by the same firm. This holder allows the incandescent lamp to retain the airy and graceful appearance that excited so much admiration when it was first publicly exhibited in

1881. Messrs. Faraday appear to have been equally regardful of the electrical security of the lamp holder. The tension on the springs connecting the lamp loops is governed by the milled nut at the top.

An Extensive System.—It is claimed that "the finest electrical department in the world" is that at the new public buildings of Philadelphia. The battery room contains 1,500 cells. We may add that the battery room in the London G.P.O. is fitted with over 20,000 cells!

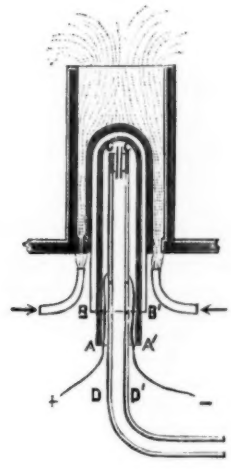
RESEARCHES ON THE TRANSMISSION OF ELECTRICITY AT LOW TENSION THROUGH THE MEDIUM OF HEATED AIR.

NOTE OF M. R. BLONDLOT, PRESENTED BY M. E. BECQUEREL.
(*Extract by the Author.*)

IN 1853 * M. E. Becquerel discovered that gases raised to high temperatures allow the electric current to pass, even when it is only derived from a single battery element. I had the good fortune, some years ago,† to confirm fully this eminent *savant's* discovery, which had been called into question.

Since that time I have endeavoured to continue the study of the transmission of the current through heated air; the complete account of the researches that I have undertaken on this question forms the subject of a memoir that I have the honour to present to the Academy, and of which I will now give a brief *résumé*.

In order to transmit the current through a motionless stratum of heated air, enclosed between perfectly insulated electrodes, I had recourse to the following apparatus: a bell-shaped vessel of glazed china is fixed vertically, the opening being at the bottom, this is enclosed in a thick iron vessel of the same shape, and the whole is heated from above by means of a modified Pérot stove. In the heated air filling the upper part



of the china vessel are placed the electrodes; they consist of two discs, c, c', of platinum, 0·03 metres in diameter, connected with two platinum rods, themselves prolonged by iron rods, D, D', fixed to insulating supports; two platinum wires issuing out of the vessel without touching anything establish communication between the discs and the apparatus outside.

On forming a circuit comprising a battery, the discs, and a capillary electrometer, I first verified the fact already made known by M. Becquerel, viz., that the current does not begin to pass until red heat is attained. Now I have already stated that the column of heated air rising from an incandescent body allows the current of a single element to pass, although a thermometer plunged into it indicates a temperature of 70° only; I think this is because the current of heated air consists of filaments or slender columns, some of which have a very high temperature, and by these alone the current is conducted.

I then endeavoured to ascertain whether, by employing batteries with lower and lower electromotive forces, we should arrive at an electromotive force below which the current would no longer pass; but I found that, when once red heat is attained, the passage of electricity takes place, even with an electromotive force of $\frac{1}{1000}$ of

* "Annales de Chimie et de Physique," 3rd Series, Vol. xxxiv., 1853.

† *Comptes Rendus*, April 4th, 1881.

a volt; thus, either there is no electromotive force below which the current does not pass, or, if there be one, it is extremely small.

The chief object of my researches was to solve the following problem: are the laws which govern the transmission of electricity through a heated gas identical with those which govern its transmission through solid and liquid bodies? M. E. Becquerel stated facts in contradiction to these latter laws; he asserted that "the resistance seemed to depend on the intensity of the current and on the number of elements in the battery." I proposed to continue the study of this question and ascertain whether Ohm's principle is applicable to heated air, or, in other words, whether the loss of electricity through the stratum of warm air is in proportion to the difference of the potentials of the electrodes enclosing this stratum.

The chief difficulty in solving this problem arises, as M. Becquerel states, from the impossibility of keeping the temperature constant. I succeeded in overcoming this difficulty by means of a special method of compensation, which I cannot describe here, and a detailed account of which is given in the memoir which I have the honour to present to the Academy. This method enabled me to state that the loss, instead of being in proportion to the difference of potential, as is the case with liquids and solids, increases more quickly than this difference. The result of my experiments is represented by a curve, the abscissæ of which represent the electromotive forces, taking as a unit the electromotive force of one element of sulphate of copper, and the ordinates the losses. The curve is considerably concave towards the top; it would have been a straight line if the air had followed Ohm's principle.

From this it follows that the heated air has not, properly speaking, any resistance, and that, if we seek to estimate the resistance by known methods, we shall find a number depending on the electromotive force and the intensity of the current, which explains the results obtained by M. E. Becquerel.

What is the mechanism of the transmission of electricity through heated air? I am led to think that this mechanism is what Faraday called *convection*, *i.e.*, the transmission of electricity by the particles of air becoming charged at each of the electrodes, and then coming into contact with the other and there discharging themselves according to the law of electrical attraction and repulsion.

Convection, which is impossible with a low temperature on account of the adherence of the air and the platinum, becomes possible with heat in consequence of the cessation of this adherence. I am, however, far from regarding this hypothesis as a demonstrated fact, and, besides, the experimental facts described in my note are entirely independent of it.

THE AUSTRALASIAN CABLE QUESTION.

THE *Australasian Insurance and Banking Record* says:—The dispute with the Eastern Extension Cable Company caused considerable stir and controversy. The several Chambers of Commerce discussed it, but decided to leave the matter entirely with the Government. A statement by the Premier to a deputation of press representatives who favoured renewal of the subsidy, had very considerable influence in winning over public opinion to the side of the Government. He said that the agreement with the company implied that the subsidy was not to be continued after the expiration of the 10 years from which it was granted. The cost of laying the cable was £300,000; but, at the present time a similar cable could be put down at a cost of £140,000, or a cable of much superior quality to the present one at £175,000.

The revenue derived from the cable has risen from £8,784 in 1876 and £13,472 in 1877 to about £21,226 in 1885, which sum did not include the amount of the subsidy. Against the amount is to be placed the sum of £2,000 which is estimated as the cost of working, so that the company received £18,626 for the cable and in addition £7,500 subsidy, bringing the total profits to £26,126 which was, the Premier argued, a very handsome return, especially when it is considered that a cable could now be laid for £140,000.

As a commercial transaction it would be far cheaper for the Government to lay a cable at the estimated cost of £170,000 than continue the subsidy, because if they only received one-half of the revenue that the company now received it would pay interest and sinking fund and the expenses of working the cable. The Government resolutely refused tc collect the increased charge upon messages lodged in New Zealand, and insisted upon holding the company responsible for the 4s. per ten words terminal charged upon all messages from Australia which the Government of New South Wales declined to collect. Affairs had thus reached the point of deadlock when the news came that the Agent-General had arranged in London for a *rapprochement* upon the basis of the *status quo ante bellum* for six months, during which the company undertake to do business at the old rates without subsidy, and to reduce press rates to 3d. per word upon being guaranteed that the aggregate revenue from this source shall not be less than before. Whether the company cherish the hope that Parliament will take a more favourable view of their claims than the Ministry have done is only known to themselves, but now that the Pacific Cable Company is a substantial factor in the field the Eastern Extension Company will have to meet the threatened opposition by the liberality of their terms rather than by attempts at coercion.

REVIEW.

*The Application of Electricity in Registering Appliances.** By Dr. ERNST GERLAND. Vienna, Pest, Leipzig: A. Hartleben.

In this work, although prominent attention is naturally given to apparatus which register phenomena by means of electricity, yet others are not absolutely excluded. Devices for signalling on railways have been discussed in former volumes of the "Electro-technical Library," and they are hence excluded, as are also apparatus not employed for scientific or technical purposes. Questions of priority concerning the date of inventions are not discussed.

We find here, firstly, a description of astronomically registering apparatus, in some of which accuracy is carried so far that the utmost possible error does not exceed a few thousandths of a second.

Then follow technical and physical apparatus for measuring small portions of time, or for speeds and work done.

Next the author turns to meteorological appliances, registering thermometers and barometers, hygrometers and pluriometers. Considerable attention is paid to anemometers. Evidently the electrical engineer requires a very accurate knowledge of the maximum pressure of the wind to which his aerial installations—*i.e.*, telegraphic and telephonic wires—will be exposed, that their strength may be regulated accordingly. But the main point is to ascertain, and of course to register, not merely the average velocity of the wind for a day, an hour, or even for much shorter portions of time, but the velocity which it may have at any particular moment. The strength of an exposed installation must be regulated according to the greatest momentary velocity which is likely to occur in the locality where the observations are made. Now, the conclusions arrived at on this subject by eminent authorities are far from agreeing. Anyone who examines the opinions on the great storm which

* "Die Anwendung der Elektricität bei Registrirenden Apparaten."

occasioned the Tay Bridge catastrophe will find abundant proof of this difference of opinion.

The last apparatus described in this treatise are those for recording the heights of rivers, floods, &c., those for registering terrestrial electric currents and for detecting and recording earthquakes, even of the feeblest degree.

This work forms the thirty-sixth volume of the justly appreciated "Electrotechnische Bibliothek" now in course of publication by Messrs. Hartleben.

THE UNITED TELEPHONE COMPANY.

LONDON, says the *Bullionist*, is not happy in its experience of scientific inventions. Either there is a fatality about them or they do not suit our foggy climate and our old-fashioned notions. Things out of which men make fortunes in the States, and which succeed even in third-rate provincial towns will not take root in the City. Can it be that the spirit of its Roman founders is still so strong in it as to harden it against modern ideas? In any case it does not readily adapt itself to innovations. Your genuine Cockney, born within sound of Bow Bells, is conservative to the marrow of his bones. He is part of a huge and complicated machine, the wheels of which have been turning round in the same way for centuries, and it is difficult to get a new notion introduced among them. As a rule he is chary of the blessings of science, and his strongest impression of scientific men is that he has been frequently taken in by them.

What a long and dismal list might be made of our scientific disappointments in the past 10 or 15 years! Our sewage was to be purified and utilised for us, but it is still flowing greasily into the German Ocean. Our houses were to be delivered from the gas-poisoning demon and to be brilliantly illuminated without heat or smell or trouble, but most of us still have the gas collector paying his quarterly visits. Last, but not least, we were to be enabled to talk to each other over a wire as quietly and pleasantly when we were miles apart as when sitting in the same room. The "long-distance talking" has been, perhaps, the worst disappointment of all. It promised great things and ought to have realised them, but nobody can tell exactly why it has not. We were to transact our business by telephone. We were to go to church by telephone. We were to attend Parliamentary debates, enjoy classical music, and exchange the news of the day by telephone. Our wives were to order the dinner joint, to send their instructions to the grocer, and to pay visits by telephone. They were delighted at the thought of being able to ring up the family doctor at any hour of the night to let him know that baby was restless, or that the head of the house had come in late and was causing alarm by his heavy breathing.

The United Telephone Company is still struggling with the harm done to its wires last Christmas. Many instruments have been speechless since that time. Many subscribers have threatened to give the telephone up, rather than be bothered with it any longer. There has been talk on 'Change and elsewhere of addressing to the company a very plain-spoken remonstrance on the erratic service it renders in return for the liberal annual subscription it charges. Inquiries which have been made on the Continent and in the provinces show that the interruptions caused there by bad weather are far less than London has to put up with. Why should this be? Are the United Telephone Company's wires of such inferior quality that they cannot bear a strain which elsewhere is harmless. Are they not so well hung as other wires, or not so well attended to, or what is wrong with them? If most of them have to be under repair during the greater part of every winter; there has been fault somewhere, either in the original construction or in the maintenance of them. To have virtually to renew many of them every spring must also be a costly business.

On this point there are some peculiar rumours floating about in the City. The expense of the renewals now going on is estimated by practical men at figures which will startle the company's shareholders when they appear in the accounts. We have heard it stated at overwhelming amounts, which would sweep away the greater part of the year's income. About the lowest that has been named is £30,000, and they run from that all the way up to £90,000. The lowest may possibly be an exaggeration, but even £20,000 would make a big hole in the company's dividend fund. In the year ended April 30th, 1886, the subscriptions in the Metropolitan district received and outstanding were £94,639, from which had to be deducted Post Office royalties and proportion of subscriptions and rentals unearned. With these deductions the gross revenue of the year was £87,530. The working expenses and other outlays exceeded £54,000, consequently the net revenue available for dividend was only £27,000. That is the United Telephone Company's own income, earned within the metropolis. It has a second and more lucrative source of income in the auxiliary companies which occupy the provinces. These paid it in royalties and dividends fully £46,000, of which over £40,000 came into net revenue.

The company does not advertise the number of its subscribers, but it is understood to be under 4,000, or about one for every 1,250 of the population. The National Telephone Company working among provincial towns far apart, and many of them so small as barely to pay expenses, has in half the time gathered nearly double that number. At the end of 1886 its exchange, private wire, and trunk line subscribers, numbered 7,157, and it earns about as much net income from £10 and £12 subscriptions as the United Telephone Company does from its £20 subscriptions.

The Lancashire and Cheshire Company, operating among a population of only two-thirds of the size of London, if so much, has gathered round it 5,000 subscribers. It gives them a far better service than London has ever enjoyed, and makes proportionately far more money than the London company does. Both the Lancashire and Cheshire and the National Telephone systems embrace an extensive network of trunk line, of which London has as yet but one example—the wire to Brighton. In the race of telephone progress the present company is being left far in the rear by its own children. It the United is to fall much farther behind it will become a serious question with the shareholders whether they should not call in provincial help. In the provinces the telephone has been made a financial as well as a practical success. In the metropolis, where it ought to have succeeded best, it has produced the poorest results. Why?

LEGAL.

Edison and Swan United Electric Light Company v. Woodhouse and Rawson.—Mr. Aston, Q.C., applied to Mr. Justice North on Friday last week for an order to enforce an undertaking given on behalf of the defendants by their counsel at the trial of the action between these parties. At the trial the defendants applied that the injunction granted by Mr. Justice Butt might be suspended pending the intended appeal, and that application was granted on an undertaking that the defendants should pay a royalty of 1s. 6d. on every lamp made by them until the result of the appeal should be known. The defendants had paid under that arrangement sums amounting to about £800, out of about £2,000 alleged to be payable, and the plaintiff company asked for an order that the defendants might be directed to pay such sum as was now due in respect of the undertaking given by Sir Horace Davey and Mr. Macrory on their behalf. Mr. Macrorie now said that there was no intention to seek to evade payment of the agreed royalty, but the defendants had not had time to make up their accounts to fix the sum payable; and it would take ten days to complete the work. Mr. Justice North said that having given such an undertaking, the defendants ought to have kept a strict account, which would at any moment show the number of lamps manufactured, and he directed that the defendants should within fourteen days state on affidavit the number of lamps made, and pay the royalty due within four days after making such affidavit.

In re the Electrical Navigation Company.—On Saturday a petition was presented for the winding up of the above company. It was stated that no shares had been allotted and but few subscribed for. The petitioner, who was a subscriber for shares, was desirous that the liquidation should proceed in the City of London Court. Mr. Justice Stirling made the usual compulsory order for a winding up, and under section 42 of the Companies Act, 1867, directed that the liquidation should be carried on in the City of London Court.

THE TRUE STORY OF THE CARTRIDGE CONTRACT.

It is very much to be regretted that as a people we are greatly addicted to thinking evil of the ways of those in authority. From time to time the columns of the daily papers are set a-bristling with sensational paragraphs of this or that scandal, and the luckless Horse Guards and Admiralty authorities are metaphorically converted into Aunt Sallies, to be hurled at by all and sundry. Almost the latest of these so-called scandals is that relating to the contract just concluded with the well-known firm of Latimer Clark, Muirhead & Co. for the supply of 500,000 Service cartridges. We have been gravely told that these gentlemen are merely the puppet representatives of German companies, that they had only recently acquired some small works at Millwall, and that, in short, so much British capital would be paid out of the country, to the enrichment of the foreigner and at the cost of the British workman.

Now what are the simple unvarnished facts, which we (*United Service Gazette*) have been at some pains to ascertain, and for the following statement of which we vouch?

To start with, Messrs. Latimer Clark, Muirhead & Co. have for many years supplied the Admiralty and the War Office with electrical projectors and other electrical and engineering work of a much more complex character than cartridges. Their work has invariably given satisfaction. Not long ago their firm were led to enter into negotiations with Herr Lorenz, of Carlsruhe, the well-known manufacturer of ammunition to the German and Austrian Governments. It is a notorious fact that Herr Lorenz has patented some exquisite machinery for making cartridges,

bullets, and ammunition. The Lorenz patent compound bullet is being rapidly adopted by the Continental Governments. In fact, his are *the* patents of to-day. But his factory is in Germany, and it would never do for us to be dependent on a foreign Power for the very sinews of war. But with capital at command the difficulty was overcome by the grand *coup* of annexing Herr Lorenz bodily, buying his patents and machinery, while securing his personal services to superintend their erection. This Messrs. Latimer Clark, Muirhead & Co. have done; a large supply of machinery is already at Millwall, and within a day or two the new section of their factory will be in full swing, not only for the manufacture of Service ammunition, but also for turning out, in any quantity, solid cartridges for large guns, up to the largest ship guns. For the latter they have also recently received considerable orders, and by the Lorenz patents cartridges can be made out of solid discs of metal of a size and degree of perfection not hitherto accomplished. It is absurd to talk of Messrs. Latimer Clark, Muirhead & Co. acting as Herr Lorenz's agents. The fact is, the firm has done an uncommonly clever stroke of business; and more, they have not alone secured to the nation the use of the best patents in Europe, but all the outlay to be spent in the manufacture of the cartridges, &c., from these patents will be spent within the kingdom.

It must not be forgotten that the firm is of no mushroom growth, possessing what has been unwarrantably stated "recently acquired" premises in Millwall. The property has been theirs for many years, and the works are well known to naval engineers as the Northumberland Ship-building Yard.

We may add that the 500,000 cartridges about which we have heard so much of late will be manufactured under Government inspection, and that the War Office expressly satisfied themselves as to the manufacture being wholly effected in England before signing the contract, which will, we are assured, be easily completed within the stipulated period.

THE FRENCH SUBMARINE CABLE OF 1851.

I MENTIONED in my communication which you printed on February 11th that the gutta percha covered wire laid between Dover and Cape Grisnez, on August 28th, 1850, after fulfilling its object by proving the possibility of submarine telegraphic communication between France and England, finally came to an end on the night of August 31st, a French fisherman hauling into his boat as much of the wire as he could manage, severing it with his knife from the rest of the line, and taking his strange cargo into Boulogne.

The brief career of this line soon led to plans of more or less merit being suggested for a substantial cable, which it was at once determined should be laid down. Before this could be undertaken it became necessary, in consequence of threatened opposition, to obtain the confirmation of the concession which, first granted by Louis Phillipe to Jacob Brett, and afterwards approved by Louis Napoleon when President, had been by Jacob Brett assigned to me on behalf of the company. I mentioned in my first communication that the most strenuous exertions were made by persons acting on behalf of the Electric Telegraph Company to induce the President to declare the concession void on the ground of non-compliance with the conditions, and means which would not be very generally considered as very creditable were freely resorted to; Louis Napoleon, however, stating that he considered those who had stood the brunt of the first experiment were deserving of every fair consideration, ordered the decree confirming the concession, extending the time by a year, and including the names of the late Lord De Mauley, Sir James Carmichael, who remained for thirty years connected with the undertaking as chairman, Mr. F. Edwards, and Mr. J. W. Brett, and the small original company was then merged in that which was then formed constituted with an enlarged nominal capital. I regret that I have no memoranda which will fix *exactly* the date of the first mention to me of the idea of wire rope for the purposes of submarine telegraphy. The person I well recollect was the late Mr. Kuper, who was at that time, or had formerly been, wire-rope making somewhere in the east of London. I can say quite positively it was a short time before August 28th, 1850; that is to say, before the first line was actually laid. After the failure of the first line it was at once seen that wire-rope was exactly suited to the purpose, and without delay the cable of 1851 was designed, submitted, and approved, R. S. Newall & Co., the late Mr. Wm. Reid, and several wire-rope makers and others being foremost with their suggestions. A great portion of the Exhibition year of 1851 had passed and little progress could be made in securing the necessary capital. The undertaking seemed to be thought too risky. Several negotiations had fallen through, and there seemed much probability of the concession being lost when Mr. Thomas R. Crampton came to the front and entered into a contract with the company to manufacture and lay the cable. The actual capital subscribed fell so far short of the sum requisite to meet the expenditure, that Mr. Crampton would have, in the event of failure, been a very heavy pecuniary loser. Mr. Crampton's other engagements at the time were so pressing that the whole of the testing of the wire and the superintendence on behalf of the Submarine Company of the manufacture of the core by the Gutta-Percha Company devolved almost entirely on myself. In consequence of petty jealousies, which one can now look back upon with a smile, the manufacture of the cable was not entrusted to R. S. Newall & Co., but was put into the hands of Messrs. Wilkins and Weatherley, who were to me represented as licencees under the then existing wire rope patent. Upon the plea (which I believe to have been a perfectly just one) that Wilkins and Weatherly were infringing the patent held by R. S. Newall and others, an injunction was applied for and granted, restraining Wilkins & Co. from manufacturing and we were forced to go to Newall & Co., by whom at the Wapping Rope Works the first cable properly so-called was manufactured and completed. The *Blazer*, a dismantled steamer, which was placed at Mr. Crampton's disposal by the Admiralty, having the cable on board left the Thames in charge of two tugs and duly arrived at Dover, and on a fine September morning the shore end of the cable having been landed immediately below the South Foreland Lighthouse, the expedition started for the French coast. Owing to insufficient brake power allowing at times the cable to run out too rapidly and the snapping of two tow ropes much cable was lost, and in the full strength of the Channel tide the *Blazer* held on stern first to the cable only! The result of these mishaps was that on arrival off Sangatte the cable was found to be about 1,000 yards short. During the delay necessitated by the manufacture of this short piece, I joined on to the submerged end a length of strand of three gutta-percha wires which had been prepared for a buried line to Calais, and by means of this uninterrupted communication between Calais and Dover was for some time carried on. About the middle of October having connected the newly-manufactured piece with the previously laid line, my association with the cable work of the French Company practically terminated.

CHARLTON J. WOLLASTON.

Lecture.—On Friday evening, the 18th inst., a lecture on Electricity and the Electric Light was delivered in the school room of the Wesleyan Church, Brockley, to a large and appreciative audience, by Mr. Henry Sherley Price, M.I.M.E., M.S.E. The lecture was accompanied by numerous interesting experiments, and was divided under the heads of Frictional, Chemical, Thermo, Magneto, and Dynamic Electricity. The room was illuminated by about 30 20-candle power incandescent lamps, the current being supplied from 27 accumulators. In the room were fitted up various descriptions of electric bells, telephones, Brush arc lamp, motors, primary batteries, &c., and during the lecture were shown and explained the numerous electrical instruments, a hand dynamo being also used for lighting table lamps. The greater part of the fittings and apparatus was very kindly lent for the occasion by Messrs. Paterson and Cooper, G. Binswanger & Co., the Stanhope Telephone Company, Limited, and Messrs. Nicholson and Jennings, and was fitted up and arranged by the lecturer's assistants, Messrs. H. Smethurst and F. Suter.

NOTES.

The Electric Light at Vienna.—According to the *Neue Freie Presse* the introduction of the electric light into Vienna is not to be expected at an early date, as the conditions demanded by the municipal authorities are practically prohibitory. They stipulate that all the plant and conductors of the undertaking shall become their property, *without compensation*, if within three months after the contract has expired, and notice has been given, all such conductors, &c., are not removed and the street restored to its former good condition. The authorities further claim the power of demanding an alteration of the conductors "on any grounds whatever," and as often as they may think proper, and, further, of pointing out "defects" in the system (either according to their own judgment, or to that of experts whom they have the sole power of selecting), and of insisting on the removal of such defects within any time at their own discretion. If any damage is perceived in the roadway, or "in other objects," the contractors may be called upon to prove that it has not been occasioned by their workmen. Lastly, for the concession to lay cables into the two Court theatres, they demand a yearly rate of 7,750 florins. This represents a yearly rent of 40,000 florins per kilometre for the cable to the Castle Theatre, and 3,400 florins per kilometre for the Opera House. How exorbitant these demands are we may judge from the fact that the Tramway Company has to pay only 2,220 florins per kilometre.

The Electric Light at Malta.—A grand ball was recently given at Malta in honour of the visit of Her Royal Highness the Princess Louise, Marchioness of Lorne. The large storehouse near the Somerset Dock, in which the festive proceedings took place, were most elaborately adorned, while for lighting purposes over 300 incandescent lamps were used with excellent effect, the apparatus being obtained from H.M.S. *Dreadnought* and from the gunboats *Dee* and *Don*. For the royal visitors a daïs was erected, this being flanked by two divers' dresses, the helmets of which contained small electric lamps. At the other end of the room a fountain was playing in the midst of a charming little grove, and here again the aid of electricity was called in to enhance the effect. Lieut. Hamilton, R.N., was in charge of the illuminating arrangements, and most efficiently discharged his duties, the excellent results he obtained being an undoubted feature of the pageant.

The Electric Light at Dundalk.—Mr. M'Carthy, who has contracted for the introduction of public lighting by electricity in Dundalk, endeavoured to make a beginning a little more than a week ago, but was not very successful, the breaking of the leather belting interfering with his arrangements. A local paper has the following with respect to the matter:—"The general opinion would seem to be that the electrical machinery at Castletown mill does not possess sufficient motive power to send the strong current needed for the lighting of a widely-extended town like Dundalk. But that opinion may after all be of little value, for very few of those who give utterance to it have any acquaintance with the *modus operandi* of lighting by electricity. They don't know what species of machine the contractor has erected—whether it is the Gramme, the Siemens, Dynamo, or a Magnetico-electrical machine!"

The Electric Light and the Panama Canal.—M. Ferdinand de Lesseps, speaking of the progress being made in cutting the Panama Canal, says that it has been decided to work night and day in order to complete the canal in three years. The electric light will be employed to turn night into day.

Edinburgh Exhibition Lighting.—The Edison-Swan Company has been awarded the only gold medal for electric lighting at the Edinburgh Exhibition.

Electric Lighting at Plymouth.—A favourable impression of the value of the electric light for commercial purposes has been created at Plymouth as the result of the experiments, extending over three weeks, recently conducted by Messrs. Laing, Wharton and Down. A few days since a number of tradesmen and others interested in the matter met under the presidency of Mr. C. Radford, and freely discussed the desirability of forming an electric light company for the town, much valuable information being supplied by Mr. Wharton. In the course of the proceedings, it was stated that the average cost of an arc light for a shop would be about £13 10s. per annum, and a company, starting with sufficient plant to work 60 lights, might pay a dividend of between 5 and 10 per cent. Mr. Wharton offered to take a considerable portion of the required capital himself in part payment of the machinery, and suggested that some similar arrangement might be made with other firms with whom it would be necessary to have transactions. Eventually a committee was appointed to canvass the town, and it was generally agreed that if 30 promises of support were obtained they would be justified in carrying forward the undertaking, as no doubt many would patronise them after everything was in working order.

The Electric Light at Portsmouth.—Although used extensively in connection with the Royal Navy, the electric light has hitherto made little progress in the town which boasts of being the "first naval seaport in the world." However, two excellent installations have for some time past been in operation on the premises of Messrs. Lancaster and Son and Mr. J. D. Antil, at Portsea; and Mr. Bishop, bootmaker, of the Commercial Road, undoubtedly the most populous thoroughfare in the town, has within the last few days followed suit.

Private Lighting in Glasgow.—The first step towards the introduction of the electric light into private houses, says a Glasgow contemporary, has been taken by a South-Side burgh, the desired end being hastened by the notoriously bad quality of gas at present supplied by the Glasgow Corporation. A city firm is at present erecting the necessary plant on the banks of the Cart to supply the inhabitants of New Cathcart and Mount Florida with the electric light. The terms are unique in their way. The rent for the use of the light is to be based on the actual quantity of gas consumed during the previous year, the receipt of the Glasgow Corporation Gas Company being accepted. Neither more nor less than the amount on the receipt is to be paid. The erection of the necessary lines has already been commenced, and three shops—a butcher's, a grocer's, and a dairy—will be first experimented on. Should the scheme prove a success at Cathcart, it will be extended to Mount Florida. The railway station at the former village will also be lighted by electricity. The Glasgow public are long-suffering, and though they may loudly grumble at the Corporation for the miserable gas at present manufactured, they have as yet taken no action to compel an improvement. The experiment now being tried at Cathcart will be watched with interest, not only by other burghs, but also by the patient ratepayers of Glasgow.

Electric Lighting of "Liberty."—The Secretary of the United States Treasury has submitted to the House an estimate of the expense of providing a permanent plant for the lighting of the statute of Liberty. The estimate aggregate $32,500. Suggestions are made for important additions to the lighting power.

The Bournemouth Lighting.—We understand that matters are not progressing quite so smoothly in Bournemouth as could be wished. The projected lighting in that town which has been mentioned in our columns on several occasions, should have been inaugurated on the 19th inst., but some hitch, probably of a pecuniary nature, has apparently cropped up.

Lighting in Madrid.—Nothing practical, the *Industries* correspondent reports, has come out of the great movement commenced about a year ago to obtain from the gas company a great reduction in price, or to go in for electric lighting at once. The price of gas continues at 9s. per 1,000 feet, and, what will appear still more strange to English readers, gas coke is sold at about 50s. per ton. The shop keepers, coffee house owners, theatre and club managers have a pretty clear idea now that they pay extravagant prices for light; but still they have not found the proper way to fight the gas company, although they have before them the example of Cadiz, where, by means of a co-operative company, gas is obtained at a reasonable price, viz., 3s. 4d. per 1,000 feet. In fact, after using petroleum for a few months, the traders are gradually returning to gas. The whole movement has been mismanaged, as at the price charged for gas the electric light could have competed most favourably. The only electric light company here is the Matritense, which evidently desires to keep on good terms with the gas company, for, as a rule, it does not supply the electric light at lower rates than would be charged by the gas company for illuminating the establishments. The Mercantile Club, for example, is charged £1,200 per annum for 150 incandescent lamps and two Gramme arcs from dusk to 1 a.m.

Electric Light on Men-of-War.—The adaptability of the electric light for use on board ship has, *Industries* states, been demonstrated to the satisfaction of the United States Navy Department, and every vessel hereafter constructed, as well as those now about completed, will be provided with the apparatus necessary to produce the light.

The Electric Light and the Suez Canal.—The Paris correspondent of the *Times* states that Mr. Gordon Bennett's yacht, the *Namouna*, passed through the Suez Canal on the night of January 29th in 13 hours 52 minutes. It had the electric light, and, being a yacht, was exempt from the rule limiting the speed to 16 kilometres an hour. This rule makes 16 hours the *minimum* time for ordinary vessels, and passages of 17 hours with the electric light are now frequently made.

Electric Lighthouses and Fogs.—The master of the Swedish steamer *Frithiof*, which arrived at Granton last Friday from Gothenburg, reports that early on Friday morning, with the very dense fog then prevailing, they had got within three miles of the May Island before the very powerful electric light recently placed in the lighthouse could be noticed, and it only resembled a dim light from a single candle. On the previous voyage this same steamer, with clear weather, sighted the May Island light at a distance of 46 miles.

Electric Lighting at Bradford.—At a meeting of the Bradford Gas Supply Committee of the Bradford Corporation, held last Saturday, a resolution was passed expressing the opinion that it was desirable that an installation of electric lighting to serve a district within a radius of a quarter of a mile of the Bradford Exchange should be made by the Corporation, and directing that Mr. Shoolbred, electrical engineer to the Corporation, should be instructed to report on the requisite works and their probable cost.

Submarine Lighting Experiments.—Messrs. Alley & Maclellan last Saturday made a successful trial in the Gareloch of their improved submarine lamp, by which objects can be easily distinguished under water. The lamp, which is of about 1,000 candle-power, can be lowered to any depth, and is intended for use in pearl-fishing abroad, but in this country will be of greater service in examining sunken wrecks, ships' bottoms, harbour works, oyster beds, and in searching for and laying submarine mines, &c. We understand that Messrs. Alley & Maclellan intend making further experiments in the Gareloch.

Electric Lighting of Peter Robinson's.—Mr. Peter Robinson's well-known establishment in Oxford Street, London, is now lighted throughout by a combination of arc and incandescent lamps, the installation having been recently carried out by Mr. Ernest G. Craven. No expense has been spared to have the arrangements thoroughly complete and reliable in every detail, and the result is very satisfactory in every way. The engine room is situated 27 feet below the level of the ground, but being lined with white glazed brick has a clean and light appearance. There are two engines on the compound principle made by Marshall, Sons and Co., of Gainsborough, each of 20 H.P. nominal, either of which is capable of carrying the whole of the lamps. Three Phœnix dynamos are employed for running the arc lamps direct, and an Edison-Hopkinson shunt machine (135 volts, 144 ampères, 1,100 revolutions) for charging E.P.S. accumulators of which there are 53 (31-L.) Altogether there are 42 (Pilsen) arc lamps and 245 (20 C.P.) incandescent lamps. The brass fittings for the latter are uniform throughout the different departments, and can be used alternatively for gas. Considerable attention has been paid to the system of switches (all of which are double pole) cut-outs, &c., so that in the way of varying the amount of light and having it just where, when, and how it is wanted, the lamps are made quite as easily managed as the gas burners which they have superseded. The installation has been carried out in strict accordance with the rules of the Phœnix Fire Office, Mr. Musgrave Heaphy having personally expressed to the contractor his gratification with the arrangements.

Fire Risks from Electric Lighting.—We are indebted to our namesake across the water for an advance proof of Mr. Henry Hine's paper on "Electricity and Insurance."

The Paris-Brussels Telephone System.—The telephone system between Paris and Brussels was opened to the public yesterday (Thursday).

Telephony in Scotland.—Telephonic communication has now been established between Glasgow and Alloa, the distance being 37 miles.

Communication was last week also opened by the National Telephone Company between Glasgow and Stirling. This is the first link in the extension of the system at present being carried through the North of Scotland. It is expected that the line to Dundee will shortly be completed, and ultimately the service will be extended as far as Aberdeen.

Volunteers and the Telegraph.—The annual distribution of prizes to the 24th Middlesex Rifle Volunteers (Post Office) took place at the Guildhall on Friday night last week. Mr. Alderman and Sheriff Isaacs presided in the unavoidable absence of the Lord Mayor, and amongst those present were the Postmaster-General (the Right Hon. H. Cecil Raikes, M.P) and Mrs. Raikes, Baron von Pawel Rammingen, the Right Hon. J. H. A. Macdonald, M.P. (Lord Advocate), Major-General Lyon Fremantle, Major-General Webber (Royal Engineers), Colonel Du Plat Taylor, Colonel V. Hatton, Major Matthey (London Rifle Brigade), Major Thompson, Major Baily, Captain and Adjutant Hervey, &c. From the annual return it appeared that the percentage of efficients was 99·30. Colonel Du Plat Taylor, commanding, said the regiment was now in its eighteenth year, and it kept up its numbers wonderfully, there being now 1,075 men on the roll, a number which he hoped to see increased to 2,000 by the end of the year. There were 100 men belonging to the Army Post Office Corps and 100 reserve trained telegraphists, and he was sure that the officers of the regulars who had seen these men in Egypt would speak highly of their services. There were still a number of men in Egypt serving as telegraphists. The prizes were distributed by Mrs. Raikes, and the Postmaster-General spoke in complimentary terms respecting the corps.

Telegraph Officers in India.—Colonel Hughes-Hallett asked the Under-Secretary of State for India on Friday last when the grant of Presidency allowances, such as were drawn by officers of the Public Works Department, would be extended to officers of the telegraph department, the power to grant such allowances having been vested in the Director-General of Telegraphs by Letter 1,001, E.G., dated July 15th, 1876, from Government of India Public Works Department. Sir J. Gorst said inquiry should be made.

False Telegrams.—Mr. Conybeare asked the Attorney-General last Friday whether his attention had been drawn to the paragraph in the *Pall Mall Gazette* of Thursday describing "an outrage of a peculiarly cruel and dastardly nature," in form of a false and unsigned telegram being sent to a certain person who was nearly killed by the shock it caused him; whether it was the fact, as therein stated, that the "author of this abominable outrage is known, but will probably escape punishment as the Post Office declines to take up the matter, and the Public Prosecutor has so far paid no attention to the representations made to him;" and whether he proposed to take any and what steps in the matter to further the ends of justice. The Attorney-General said that the facts did not disclose any offence against the law, and that he was not aware that the receiver of the telegram had made any complaint to, or held any communication with, the Public Prosecutor.

Telegraph Clerks.—In the House of Commons on Tuesday Mr. H. S. Wright asked the Postmaster-General whether the title "clerks," as mentioned in the Telegraph Act, 1868, carried with it the salary and privileges of clerks in the Post Office, to which department telegraph clerks are attached. Mr. Raikes replied that there are in the department a variety of clerks, male and female, with a corresponding variety of salaries. The Act did not define the salary or privileges of any officer or clerk in the Post Office. The class of persons in question had had their salaries considerably augmented since they were incorporated in the Civil Service.

Laying a Cable.—Writing from Gibraltar, a correspondent states that the Eastern Telegraph steamship *Electra* has successfully laid the cable between that fortress and Tangier (Morocco), the first telegram being despatched by the editor of the *Eco Mauritano*, congratulating the Gibraltar Press on the establishment of a line of communication which cannot fail to be of service to both places. The tariff for messages is 2d. per word.

Submarine Cable between Massowa and Perim.—Merrs. Pirelli & Co., of Milan, who own the largest India-rubber factory in Italy, have entered into a contract with the Government, states *Industries*, by which they have undertaken to lay a cable between Massowa and Perim within two months' time. Arrangements have been made with the Eastern Telegraph Company, of London, for carrying out the contract on joint account. The Eastern Telegraph Company have already 440 miles of cable ready for laying, on a steamer lying at anchor in the Red Sea.

Electric Hair Brushes.—The prospectus has been issued of the Electric Battery Brush Company, which has been formed for the purchase of the patents and extension of the sale of McMullin's electric brushes. The capital is £50,000 divided into 10,000 shares of £5 each. One could almost imagine that the article to be sold is the veritable "Father Brush," for we read that it will deflect a galvanometer, ring bells, decompose water, and do, indeed, anything within the power of an electric current. We notice, also, that it stimulates the growth of the hair, and, as we oftentimes have a difficulty in "keeping our hair on," we should be pleased to try its effects upon our venerable locks if the company will submit a specimen to us.

Electrical Communication with Lightships.—The Board of Trade has appointed the following as a Committee to inquire into and report on the desirability of electrical communication between light vessels and the shore, with the special object of facilitating the saving of life at sea, viz.:—The Earl of Crawford, Colonel King-Harman, M.P., Sir Edward Birkbeck, M.P., Rear-Admiral Sir George S. Nares, Mr. C. Cecil Trevor (Assistant Secretary to the Board of Trade), Mr. Thomas Sutherland, M.P., Captain J. Sydney Webb (Deputy Master of Trinity House), Captain H. M. Hosier (Secretary to Lloyds'), and Mr. Alfred Holt. The Committee will be instructed also to consider whether a system of electrical communication should be applied to outlying lighthouses; whether the experience gained by the present cable to the "Sunk" light vessel has proved of sufficient value to justify the cost; whether the system should be further extended; and whether it is desirable that any of the stations to which the system is applied should be also used as signal stations for commercial purposes. The first meeting of the Committee will be held at the Board of Trade on Monday next, the 28th inst. Mr. J. Waddon Martyn has been appointed Secretary to the Committee.

Underground v. Aerial Lines.—With reference to Mr. Callender's letter in our correspondence columns, as there are several points of interest involved in the questions and criticisms, we shall refer to the same at length in another issue.

The Motor Challenge.—Doubtless, Profs. S. P. Thompson, W. E. Ayrton, and J. Perry, together with Mr. Mordey, will immediately accept the challenge thrown out by Mr. Frank J. Sprague, give up their daily occupations *pro tem.*, and set to work to construct presentation motors. For the purpose there is no time like the present, for is not this the Jubilee year? What a pity the idea did not suggest itself to Mr. Sprague that the competition should be embodied in that recently promoted by *Industries*. We would further refer readers respecting this matter to our correspondence columns.

Erratum.—The sum paid by Messrs. Woodhouse and Rawson to the Edison and Swan Company on account of royalties due is £816 and not £1,816 as Sir Horace Davey is reported in our last issue to have stated.

New Electric Lighting Plant.—A very neat and compact electric lighting plant was shown in operation a few evenings since at the works of Mr. Peter Brotherhood. It has been designed for search-light purposes and the combination consists of a small 3-cylinder Brotherhood engine with one of the Brush Corporation's Victoria dynamos. The apparatus is intended for use on board ship for the navigation of canals or other narrow waterways. In our next issue we shall hope to illustrate the combined engine and dynamo and also the search lamp.

Lightning Conductors.—Herr Schiller, a well-known German architect, reports some facts which are of interest as indicating the radius of the circle of protection of good lightning rods. On June 17th last, at the village of Mottingen, lightning struck a pear tree, 33 feet high. On one side, 115 feet away, was a schoolhouse, with a rod 56 feet high. On the other side was a church, 328 feet away, and having a lightning rod reaching up 154 feet. Both rods are well placed, and had worked well when tested, and the level of the foot of the tree is about the same as that of the two buildings.

Copper Wire.—We have received some samples of very nice high-conductivity copper wire, both tinned and soft, manufactured by Messrs. Frederick Smith and Company, of Halifax. We understand that Messrs. Walter T. Glover & Co., have arranged to take charge of Messrs. Smith's interests in copper wire, from their London office (10, Hatton Garden, E.C.), and from Manchester.

The Carriage of Electrical Machinery.—It will be gratifying to those interested in the electrical industry to learn that, as a result of the agitation which was commenced in the spring of last year by the Anglo-American Brush Electric Light Corporation for an alteration of the railway classification as regards the carriage of dynamo and other electrical machinery, it has been decided that the Clearing House classification for apparatus of this description will now be :—Not packed, 3 Y ; in cases, 2nd. The reduction of rates effected by this alteration represents a very considerable saving in the expenditure for carriage of dynamo and other electrical machinery, and the thanks of the trade are due to the Anglo-American Brush Corporation, and to the firms who have energetically co-operated with it in obtaining this trade concession from the railway companies.

Something Great in Cars.—It will be remembered, says the *Electrical World*, that during the latter half of the past year the Sprague Company were experimenting with motors on the Thirty-fourth Street branch of the Elevated Railroad. On the 28th of December these experiments were brought to a close for the time being, but, it seems, only to be renewed on the most extensive scale. The company has now engaged one of the best known car builders in the country, and is completing its designs for a 28-ton motor car. This car is to be of special construction. It will be 42 feet long. The central space is to be devoted to passengers and each end reserved for the engineer. The car is to have two trucks, each of which is to be equipped with two duplex motors of 75 horse-power each, operating upon 42-inch driving wheels. The car will, therefore, have eight 42-inch driving wheels, with four independent axles and two independent trucks, and the motors will have an aggregate capacity of nearly 300 horse-power. This is about 60 per cent. more than the present locomotives have when crowded to their utmost. All the weight of the car, 28 tons, is effective for tractive effort as against 15 tons of weight on the driving wheels of the present locomotives. Although the capacity of the motor car will be 60 per cent. greater than that of the locomotives, and its tractive weight about 90 per cent. more, the running strain on the structure is reduced about 20 per cent. because of the distribution of the weight over 42 feet instead of over a few feet as in the present locomotives. The best known firms in the country in their particular specialities are to be employed upon this car. The work is to be pushed as rapidly as possible, and when finished the car will have ample capacity to handle a 120-ton train and make time.

Electrical Transmission of Power and Lighting in New Zealand.—We are glad to notice that the antipodes are fully awake to the fact of electricity being an important industrial adjunct, not in the sense altogether of that well worn word "future," but rather in the "present," for we notice the successful formation of a company called the "Reefton Electrical Transmission of Power and Lighting Company," the result of some lectures and ocular demonstrations of both these branches of the modern "Hercules," by Mr. Walter Prince, an electrical engineer of considerable name in the Britain of the South, for accomplished successes of both power and lighting. We understand that the company in question starts work with about 500 lamps and 60 H.P. transmission for mining work, and that Mr. Prince expects to complete the works in about six months. Water power is the initial source of energy.

Festivities.—On the 17th inst. the engineering staff of the G. W. R. telegraph department at the Chippenham Depôt held their first annual supper, and a most enjoyable evening was spent. It being the birthday of Inspector Barter, who presided, a handsome silver tea service was presented to him.

The annual dinner of the members of the clerks' library of the Submarine Telegraph Company was held at the Talbot, London Wall, last Saturday evening, Mr. Ducloy in the chair. The Chairman stated that in the library not only was recreation provided for, but more solid materials were to be found, and especially all the best works that had been written on their particular science, electricity. A great deal of credit for this was due to Mr. Sharkey, their vice-chairman, and Mr. Mullane, their most excellent secretary, who had worked hard and unflaggingly from its first institution to the present moment.

The annual dinner and meeting of the non-commissioned officers of the 2nd Division Telegraph Battalion Royal Engineers in charge of the Post Office telegraphs throughout the southern counties of England, took place last Friday evening at the Masons' Hall Tavern, Basinghall Street. There were present during the evening Mr. C. H. B. Patey, C.B., Major-General C. E. Webber, C.B., Colonel W. Salmond, R.E., Mr. E. Graves, Mr. W. H. Preece, F.R.S., Lieut.-Col. R. H. Jelf, R.E., Major C. F. C. Beresford, R.E. (commanding 2nd Division), Captain G. W. Addison, R.E., Captain F. G. Bowles, R.E., Captain R. L. Hippisley, R.E., Lieut. Sir R. W. Anstruther, Bart., R.E., &c.

Electrical Engineering Football Club.—The next smoking concert in connection with the above club will be held at the Mason's Hall Tavern, Basinghall Street, on Wednesday, March 9th.

Disputes about the "Great Eastern." — In the Queen's Bench, on Tuesday, a criminal prosecution was commenced against Mr. Wm. Barber, chairman and director of the *Great Eastern* Steamship Company ; Mr. M. E. Marsden, another director ; and Mr. Thomas Brown, shipbroker, on account of an alleged fraud in connection with a charter party entered into with a syndicate formed for the purpose of fitting up the *Great Eastern* as a floating hotel, to be stationed at New Orleans in 1884. The case has been removed by *certiorari* from the Central Criminal Court.

Elevated Electric Railway at Elberfeld.—Two Berlin firms have planned an elevated electric railway for Elberfeld and Barmen. The line is to extend from the Zoological Gardens at the extreme west of Elberfeld to the east end of Barmen and Rittershausen. It is to be conveyed over the bed of the Wupper at the height of 5 metres above the bridges. Strong iron pillars will support the line, and in order that they may not be attacked by the acids which flow into the river from the chemical works, they will be surrounded with concrete. The expense of the undertaking is estimated at $5\frac{1}{2}$ million marks. The authorities of Elberfeld entertain doubts lest the pillars may interfere with the free flow of the Wupper, *e.g.*, in time of flood.

Accumulators Extraordinary. — A correspondent writes :—He is most successful as a scientific lecturer who describes the phenomena with which he deals in the language most familiar to his audience. For this reason probably the principal of a technical college defines the results of certain experiments as coming out "all very fine and large," and describes to his electrical class the peroxide plate of an accumulator as resembling in colour "Ruddy-gore." What will this too awfully funny Professor say next ?

Made Useful at Last.—Some inventive genius, according to the New York *Electrical Review*, has devised a means whereby the present form of wire bustles can be made useful as well as ornamental. In short, the bustle is provided with two binding nuts from which leads are carried to an incandescent electric lamp on the head of the wearer. The bustle serves as a sort of secondary transformer, and it is only necessary to approach an electrical conductor to have the lamp glow brilliantly. The claim is for the combination of the girl, the bustle and the lamp.

Personal.—It is rumoured that Mr. Stevenson Blackwood will shortly resign his post of Secretary to the Post Office, and that Mr. Patey, now third secretary, will succeed him.

A Cavalierly Way of Doing Business.—At the last meeting of the Bath Town Council, the Mayor announced the receipt of "a very long letter" from the telephone company, complaining strongly of its disappointment at the non-success of its efforts in Bath. There was a lot of business to do, and he thought it would be as well not to trouble them with it. Mr. Dyer inquired whether the letter requested the corporation to do anything, because if it did it ought to be read. The Town Clerk replied that the communication was at his office if anyone wished to read it. He had not done so himself. We were not aware that well-paid officials are permitted to leave letters on corporate business unperused.

Sale of the "Great Eastern."—Last week Messrs. C. W. Kellock & Co., Liverpool shipbrokers, put up for auction, without reserve, the steamer *Great Eastern*. The bidding commenced at £5,000, and the steamer was eventually knocked down to Mr. Thomas Brown, of London, for £26,000. At the previous auction in London she was sold for £16,000, but the auctioneer stated that during the six months she was on exhibition the vessel made a profit of £20,000. It is reported that, in purchasing the ship, Mr. Brown was acting on behalf of an Australian steamship company.

Murder of an Eminent Physicist.—Dr. Pebal, professor of physics at the Graz University, has been murdered by a laboratory assistant whom he recently dismissed from his service, and who, on the approach of the police to arrest him, committed suicide by swallowing poison.

Underground Wires.—At a meeting of experts in telegraphic and telephonic science, held at the Café Royal, Regent Street, Mr. Donald Nicoll, A.I.C.E., read a paper on "Underground Telephone and Telegraph Communication. The paper has been reproduced as a pamphlet, entitled "Underground *v.* Overhead Wires," by Mr. R. Booth, 12, Buckingham Street, W.C.

The Lighting of the Temple.—Messrs. Mortimer, Shepherd & Co., who have for some time been engaged in experiments upon the best mode of lighting this church with incandescent lamps, have now concluded their labours, the result ultimately achieved being that the building is efficiently illuminated without marring in any way the fine effect of the beautiful interior. The lamps are so arranged about the capitals of the pillars that the source of light is hardly perceptible; and the massive brass standards, which though handsome in themselves formerly obstructed the view, having been removed, the result is really an improvement in general effect. The same firm has also introduced the electric light into the Inner Temple Hall, where the existing elaborate brass gas fittings have been utilised, four 16-C.P. lamps being substituted for seven gas burners on each of the brackets arranged against the walls of the hall. Due care has been taken to provide against risks, and the work in both these cases has been carried out with a thoroughness very creditable to the contractors.

He was Shocked.—On the evening of September 11th, 1886, the New York *Electrical Review* states, George Christian was sitting on the gallery or balcony of his boarding house in New Orleans. A breeze was blowing with enough power to throw the wires of the Louisiana Electric Light and Power Company against the railing of the gallery upon which Christian's hands were resting. The wires also touched his hands and he was severely shocked, being thrown from his chair. He asks for $1,680 damages, alleging carelessness on the part of the company in stringing its wires with a slack sufficient to allow of their being blown against the gallery.

Electric Lighting in Boston.—The Mayor of Boston gives the following facts concerning electric lighting in that city:—The report from the lamp department includes these statistics: number of lamps of all kinds in use in the city of Boston on January 1st, 1886—gas, 9,978; oil, 2,630; electrics, 446; large gas lamps, 63; total, 13,117. On January 1st, 1887, the number was, viz.—Gas, 10,057; oil, 2,785; electrics, 494; large gas lamps, 59; total, 13,395; increase, 278. The increase of the separate sections of the city has been as follows: Roxbury, 28; West Roxbury, 78; Dorchester, 105; South Boston, 26; East Boston, 23; Charlestown, 3; Brighton, 20. The number of gas and oil lamps put up during the past year was 367. The number of oil lamps changed to gas lamps was 29. Electric lights: January 1st, 1883, 114; January 1st, 1884, 381; January 1st, 1885, 401; January 1st, 1886, 446; January 1st, 1887, 494; increase during past year, 48.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Incandescent Gas Light Company, Limited.—On an agreement this company will purchase the patent rights of Carl Auer von Welsbach, of Vienna, granted for his system of incandescent gas lighting, in the following countries:—Belgium, Cape of Good Hope, France, Finland, Italy, India, Norway, New South Wales, New Zealand, Queensland, Spain, South Australia, Tasmania, Victoria, and Sweden. The purchase consideration is £300,000, payable £60,000 in cash, £100,000 in fully-paid shares, and £140,000 in cash or shares at the option of the directors.

New Electric Light Syndicate, Limited.—The registered office of this company is at 2A, West Street, Finsbury Circus, E.C.

Elwell-Parker, Limited.—The annual return of this company made up to December 24th, 1886, was filed on December 28th. The nominal capital is £50,000 divided into 4,500 A and 500 B shares of £10 each. 2,470 A shares have been taken up, and upon 1,500 of these the full amount has been called, and £7 per share has been called upon the remaining 970 A shares. 100 B shares are allotted upon which the full amount has been called up. The total calls paid up amount to £22,790.

CITY NOTES, REPORTS, MEETINGS, &c.

Anglo-American Brush Electric Light Corporation, Limited.

YESTERDAY the sixth ordinary general meeting of this company was held at the Cannon Street Hotel, under the presidency of the Right Hon. Lord Thurlow, F.R.S. The report, which appeared in last week's REVIEW, was taken as read. The balance sheet and profit and loss account were as follows:—

BALANCE SHEET, 31ST DECEMBER, 1886.—*Dr.*—To capital, 25,327 shares of £5 each fully paid, £126,635; 23,003 shares of £5 each £3 paid, £69,009—£195,644; 254 shares of £5 each fully paid, that being the maximum number of shares which may still have to be issued at the request of the liquidators of the Great Western and Brush Midland Electric Light Companies, in pursuance of the agreements intered into with those companies, £1,270—£196,914. To creditors, £12,848 1s. 1d.; provision for shares in other companies, £14,000; balance of profit and loss account, £1,532 0s. 9d.—total, £225,294 1s. 10d.

Cr.—By patents, £53,086 13s. 11d.; property, £50,577 12s. 8d.; stock, £65,815 9s. 11d.; debtor balances, £30,601 8s. 4d.; suspense account (for charges and expenses in connection with litigation, £2,701 10s. 3d.; cash, £6,232 7s. 3d.; shares and debentures in subsidiary and other companies, £14,991; assets realisation accounts, being balance of assets still to be dealt with by the liquidators of the Great Western and Brush Midland Electric Light Companies, £1,287 19s. 6d.—total, £225,294 1s. 10d. The corporation have a claim to one-third of the profits made under the Brush patents for France.

PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1886.—*Dr.*—To general charges, viz.:—For the management, and for the manufacturing, engineering, contracting, designing, and technical departments—rent, £1,593 11s. 1d.; rates and taxes, £589 4s. 4d.; water and lighting charges, £404 9s. 4d.; fuel (exclusive of amounts charged to supply stations), £785 0s. 8d.; directors' fees, £1,500; auditors' fee, £52 10s.; salaries (exclusive

of proportion charged to suspense, development of patents, and other accounts), £4,338 9s. 2d.; law charges, £954 9s. 11d.; insurance, £591 13s. 4d.; postages, stationery and printing, £837 10s. 7d.; travelling, carriage and freight, £822 18s. 1d.; advertising, agency charges and sundries, £1,354 0s. 5d.; balance carried to balance sheet, £1,532 0s. 9d.—total, £15,355 17s. 8d. *Cr.*—By balance of profit from last year, £924 17s. 1d.; gross profit, £14,431 0s. 7d.—total, £15,355 17s. 8d.

The following resolutions were submitted to the meeting as special business:—

1. "That the provisional agreement entered into between the International Electric Company, Limited, by Ernest Cooper, the liquidator, of the one part, and the corporation of the other part, dated 31st December, 1886, and submitted to the meeting, be, and the same is, hereby sanctioned, adopted and confirmed, and that the directors be authorised to carry the same into effect, with or without modification."

2. "That in accordance with the terms of the agreement mentioned in the above resolution, the directors issue to the liquidator, or to such persons, and in such manner, as the liquidator of the International Company shall in writing, direct, fully paid £5 shares in the capital of the corporation, such shares not to exceed in number 1,476."

3. "That the directors be empowered to issue and offer at such times, to such persons, whether members of the corporation or not, and at such premium, but not under par, as they may think fit, not exceeding 10,000 shares in the capital of the corporation, on which £3 will be called up."

Mr. E. Garcke, the secretary, having read the notice convening the meeting,

The Chairman, in moving the adoption of the report and accounts, said that the circumstances of the past year had been of a specially anxious character, and had proved distinctly that little, if any, general progress in electric lighting was possible until the unfortunate Act of 1882 was amended. Then there was no disguising the fact that the continued depression had caused even less demand for electric lighting than in previous years. Where enterprising manufacturers had had the courage to embark in electric lighting plant the result had been eminently satisfactory. In most respects the volume of business had increased to a certain extent, though not to the extent anticipated; but there had been a decrease in profits. The reason for this was the fall in prices, which in some cases were not more than half what they were in 1885; this was mainly owing to the very large increase in the number of competing firms. Against such distinguished firms as Messrs. Crompton and others they could have no complaint, but they had to compete with cheap and unscrupulous contractors, who professed to execute electric lighting installations at low prices, but who, in order to obtain any profit at all, villanously scamped the work. The dishonest work of these men had led to loud complaints on the part of the fire insurance offices, and the public were led to believe that electric lighting was unsafe. In one class of dynamos the sales of the corporation in 1886 exceeded those of 1885 by 10 per cent., but the profits on those machines were reduced by 20 per cent.; in incandescent lamps the sales had increased 20 per cent. during the year, but the profits remained stationary; in carbons the sales increased 7 per cent., and the profits fell 60 per cent. These figures would explain more clearly than words of his could do how circumstances beyond their control had forced the directors to come before the shareholders without offering them a dividend. But bad as these circumstances were, they showed that electric lighting, despite difficulties, was gaining ground, however slowly. Dealing with the accounts, he said that unsatisfactory as was the balance of £1,532, there was yet the consolation that it was on the right side. With regard to the patent accounts, he did not think the patents stood in the books at one shilling more than they might fairly stand at. It must be remembered that the valuation of patents had been reduced since 1882 by no less than £179,466; and since 1883 the patents had practically been cut down by £126,379 13s. 11d. Considering what had been done in writing off in the course of four years he thought they might fairly abstain from further cutting down; the principal reason for raising them this year was that the board had continued the policy it adopted three years ago of reacquiring the rights which had been disposed of to subcompanies. Now they had a free hand to work in any part of Great Britain, excepting Hastings, or anywhere in Ireland with the exception of Dublin. They had repurchased for £12,500 in cash and shares property which they sold for £310,000 in cash and shares in 1882, and it was a source of great satisfaction to him, although he was not an original shareholder, that a substantial slice of the difference had gone into the pockets of the original shareholders. Notwithstanding all that had been said against it, the company still retained the position of having paid, during the five years it had been established, dividends at the rate of 23½ per cent. to its original shareholders. He did not wish to be unduly sanguine, but was bound to say that when he perceived the tendency of electric lighting business to go forward on the slighest provocation, and when he knew, as he did know, that it was only waiting for an Act of Parliament to make it possible to go forward with giant strides, he was sanguine enough to look forward to the day, and a not far distant day, when the company would again be paying its 23½ per cent. per annum. After expressing his hopes of obtaining important contracts in connection with the lighting of the City streets, the lighting of railway trains and ocean steamers, and stating that the Peninsular and Oriental Company had already placed two of its steamers in their hands for illumination, the Chairman alluded to the Bill introduced by him in the House of Lords for the amendment of the Electric Lighting Act of 1882. He said he believed Parliament would be willing to extend the period before compulsory purchase by local authorities could become possible from 21 to 42 years, and to permit a fair and reasonable valuation of plant and machinery, but the moot question was with reference to the valuation of goodwill. To what extent Parliament would go in this respect he was not prepared to say; but it seemed to him that it had only one alternative, and that was to still further extend the time to 50 years. He had had some communication with the Government, and it had expressed itself in a friendly spirit, and, without committing itself to supporting his (Lord Thurlow's) Bill or to any legislation, had assured him that the subject would receive fair consideration. He had expressed to the Government his willingness to withdraw his Bill in favour of any Government measure drawn on the same lines if it would undertake to introduce it during the present session.

Mr. J. S. Sellon, vice-chairman, in seconding the motion, spoke with reference to the recent and pending litigation respecting incandescent lamps. Mr. Forbes, chairman of the Edison-Swan Company, had recently said that his company possessed the key of the position, but he thought he might claim that the Brush Corporation held the master-key. The aggressiveness of the Edison-Swan Company had necessitated their entering upon costly preparations for the defence of their rights, and though such expenditure was to be regretted, yet there was satisfaction in knowing that they had rendered their position impregnable, and that their special processes of manufacture could not, in their opinion, be interfered with. Despite the apparent momentary advantage which the Edison-Swan Company possessed in having wrenched decisions in their favour, it was well known by many behind the scenes that much of the evidence given on its side would not bear the ordeal of critical examination, and that that given on the other side failed to deal with many of the main points involved, and thus the judgments, though they might be justified in some manner by the evidence before the judges, were given upon grounds which, in the light of the knowledge which they possessed, appeared to be indefensible. Not only were the directors confident of being able to defeat any assault that might be made upon them, but in an action which, in consequence of the mode of procedure adopted by the Edison-Swan Company, and in defence of the interests of their own company, they had been obliged to bring against the former, they had little doubt of reversing the position, of placing the boot on the other leg, and making their opponents tributary to them. As justice must prevail in the end, he felt sure it would be eventually realised in the electrical world that to Mr. Lane-Fox belonged the credit of being the first real inventor of incandescent electric lighting in its essential details, and that his marvellous perception, ingenuity, and foresight had covered the ground before all others. There was a Latin saying, *Palmam qui meruit ferat*, and that he thought was very appropriate in this case. The glamour which in the last trials had been cast round the Edison patents by the highly-talented advocates who had fought his case, and the misconceptions forced upon the minds of the judges by the peculiar character of the evidence given on the one side and the lack of evidence on the other, which induced them, to use their own amazing words, to believe that no ray of light had ever been given out by an electric lamp before the Edison lamp, would be dissipated when the fact was proved and realised that, not only had brilliant lamps been made before Edison's much vaunted patent, but that no successful lamp ever had been or even could be made under the specifications of that patent alone. He begged the shareholders not to think that their resources would be needlessly wasted in litigation. The policy which commended itself to the directors was a conciliatory one. They had never attempted to harass other manufacturers, but had readily granted terms in no way onerous; and he would say frankly that if the Edison-Swan Company could prove, what the decisions recently given had certainly not done, to their satisfaction that anything they made and sold infringed its rights, they would at once in a proper spirit recognise the fact and readily pay royalty. At the same time they should expect the same justice to be meted out to them and should claim recognition in a substantial manner of the rights which they possessed.

Major-General Webber addressed the meeting with reference to the Callender-Webber underground mains and other subjects, and after a brief discussion upon minor points the motion was put to the meeting and carried unanimously, The special resolutions given on the preceding page were afterwards agreed to, and the meeting terminated.

The Swan United Electric Light Company, Limited.

MR. J. S. FORBES presided, on Tuesday, at the fourth ordinary general meeting of the shareholders of this company, held at the Cannon Street Hotel.

Mr. C. H. Stearn (managing director) having read the notice convening the meeting,

The Chairman said: Gentlemen, I take it that you have all had a copy of the report, and that you will take it as read. It is very short, and not too satisfactory. Perhaps I had better take you at once to the accounts, for that is the essence of it. It all lies in the second sheet, and I will begin with the profit and loss account, as that is really the story of the year. You will see what

it is. There has been some progress, because the figures, if you have an opportunity of comparing those of the previous year with those of to-day (and I am not sure whether we could not print, in the future balance sheets, the corresponding figures of the previous year)—I say, in comparing the figures with those of the corresponding year, we have made some progress in the sales; and after all that is the kernel of the nut—£22,000, as against £18,900; transfer fees, interest, &c., £1,269, against £213; stock on hand, September 30th (which is the period up to which we are dealing with now, a little late in the year it is), £8,945, against £7,111; stock on starting the year, October 1st, 1885, £10,598, considerably greater than in the preceding year when it was £4,187; purchases, £4,763, against £12,708; directors' fees, salaries, &c., £2,267, against £4,484; Mr. Swan's salary £1,000, less proportion payable by the Edison Company, £600; the total of these several items is £2,667 against £5,217. You will see that we have specially reserved, against depreciation of plant, £3,000. I will explain that presently. You will see that below that is a balance of profit for the year, £4,768, which would have been, of course, entirely to the good, but for the special reserve against depreciation of plant. That leaves a balance of £1,768 to the good, which we have carried to the diminution of the loss in the balance sheet, which, if you will look at it, up to the 1st September, 1885, was £7,602. We have applied the profit up to the 30th September last to the diminution of that. Having just skimmed through that, I will follow the order of the report on the subject of the accounts. The application of that small available balance in the writing down of the loss is so much to the good, because it is quite clear that we must wipe out the loss on the early years of trading before we can distribute the profit of succeeding years. Instead of applying the whole of the profit of the year to the diminution of the previous loss, we have carried £3,000 to a special reserve. According to the law in France, in order to maintain these patents, you must, in the country itself, manufacture; and we began by manufacturing at Lille. We expended a considerable amount of money, as you will see by the previous accounts, in the premises, plant, &c. As there has been in France such a change of law as enables us to materially reduce the establishment there, and as we find in Germany a much greater possible development of traffic and labour and so forth, rather more manageable and more economical, we have determined to make, for the present at any rate, Kalk, near Cologne, our chief factory, where we shall manufacture lamps, not only for the consumption of France, but for outlying countries, and restrict the Lille factory to lamps required for France only. At Kalk we have an excellent factory, with an intelligent staff of workmen, and ample means of extending it. In view of any possible loss incurred in removing from Lille to Kalk, we have thought it worth while to carry £3,000 to the reserve, until we know the worst of this business. With reference to the state of things abroad, litigation exists there as it does in England, and I hope it will have the same result. It is only within the last two or three weeks that, on appeal, we have succeeded so far in establishing the patents of the two companies, Swan and Edison, which make this business, or will make it, so valuable. It has been a slow and costly process, and after having spent a good deal of time and money and patience, we have succeeded now, in appeal, upon two of our most important patents, the Edison and Cheesbrough. The same thing in Germany. I explained at the last meeting how it stood. There the Swan and Edison Companies, instead of putting their horses together, and presenting a strong front to the world, generally are litigating. Mr. Swan says that Edison is a bad man and a great infringer; Mr. Edison says that Mr. Swan is a bad man and a great infringer. We are face to face with the Courts. We are now appealing. The Swan Company did not succeed in the first tussle, although they had the report of the technical department of the Patent Office of Berlin in their favour. The Court which has decided here came to the conclusion that there was no infringement. Well, we are doing there what other people are doing in England. We are appealing; and we have some reason to believe and hope that, so far as the technical German legal mind has expressed itself we have some reason, I say, to believe that we may succeed. We do not want to press the issue, therefore we have tried negotiation; but the German mind is a little hard, and very difficult to move from a position; and although there have been numbers of propositions as to the terms upon which we should fuse, we have not been able, on our side, to concur in the views of our friends. They are a little too hard, as is the German manner. They want 25s. per sovereign, and we do not see how we are to give it. There is one safeguard there, however, which does not exist in England—you can call upon the patentee there to manufacture at a moderate rate (supposing we are beaten, and I think it is not very clear that we shall be, but if it were possible), then we should get a decree of the Court authorising us to manufacture the lamp under our own conditions, conditional upon paying some small royalty to the Edison Company. As ours is the better lamp by a great deal, and we feel that we can manufacture it as cheaply as Mr. Edison, probably the power to manufacture and sell at a small royalty, coupled with the control of the market in price, would put us in a position of some advantage. I hope, myself, that it will end in fusion, because I am sure what we have done in England wisely, may be well done in Germany. While the litigation is pending, there is no doubt the public are prevented from going as fully into the use of this lamp as they would, but it is going on rapidly. One sees that in this country it is beginning to take a start. Sir Edmund Coutts Lindsay, of the Grosvenor Gallery, is forming a company for the lighting of that gallery, and one needs only to go there at night to see what a valuable institution the Swan lamp is. The Swan lamp is a beautiful one for showing off pictures at night. Sir Edmund Coutts Lindsay is now lighting a great area in the Grosvenor Gallery by means of our lamps, and is extending it in all directions. The engineer of that company told me the other night that they were about to start (in fact, they *did* start on Saturday night), a dynamo for 7,000 additional lights, and in the course of twelve months from this time they will have erected on the south of the river premises in which they can drive 200,000 lights. This is very satisfactory to us, because one of our principal assets is in the Edison and Swan light in Britain, and we can hardly believe that such an extension of the electric lighting as that suggested by Sir Coutts Lindsay can be otherwise than beneficial to us, ours being the only lamp now to be tolerated in Britain. Every lamp to be made and sold by us, to whom others will have to pay a small royalty. If you look at the balance sheet you will see that a considerable portion of our interest is invested—more than half our capital. There is, in the Edison and Swan Company, £208,478. There is a crumb of comfort in our holding that enormous share in the British company. The Court of Appeal, as you will see in paragraph 5 of the report, have upheld the judgment of Mr. Justice Butt in reference to these patents. It is within the bounds of possibility that the British company may, under the influence of this decision, and by the possible expansion of business, be, at perhaps no distant date, in a position to pay a moderate dividend. Every 1 per cent. will give you £2,000 of net income; every 2 per cent. £4,000; and so on. So that when they come to pay a moderate dividend, say, of only 5 per cent., a small contribution considering the benefits that they have bestowed upon the community and the risks they have run, £10,000 per annum will be given you, and that sum of £10,000 per annum will enable you to pay 3 per cent. upon your whole capital, assuming (which is exceedingly improbable) that the foreign business is worth nothing. Mr. Stearn, I believe, has a belief that the foreign business is even better than the English business. If it is better, the two elements thus working together will give a considerable income. You cannot expect the progress of electric lighting on the Continent to be rapid in the face of litigation and competition. I daresay the competition will bring about a greater development of it. Our company have determined not to run the risk of installing. We are content to fill the modest *rôle* of lampmakers, resting on the certain ground that the lamp is the key of the position. Any man is welcome to put his money into the laying down of machinery and wires, but we mean to gain our profits from those little balls which are your property. We hope, in a reasonable time, to begin to reap a harvest. We have had a long time to wait for it, but that is in the nature of the case. I will now move that the report of the directors, and the accounts, be received and adopted.

Mr. F. R. Leyland (deputy chairman of the company) seconded. He said: After the remarks of the chairman, I think it is not necessary for me to say much. I should wish, however, to remark a little upon one point to which he adverted, and that is the congratulation that he thought we might fairly take to ourselves on the success of the action on the Edison patent that we had in this country. It would appear at first sight rather inconsistent that, having succeeded in establishing the validity of the Edison patent in this country we should hope to succeed in establishing its utter invalidity on the Continent. Because if it is valid on the Continent, as it is here, it is quite clear that if we are there in the reverse position to that in which we are here, we should be infringers. But there is an explanation of that, and that explanation is a very simple one: that the Edison patent abroad is not framed on the same lines as is the Edison patent in this country. The claim of the Edison patent on which we succeeded in this country in establishing the validity of the patent, is not in the patent abroad. The authorities, on the application of Edison for that claim to be admitted in his patent, utterly refused to allow it to be put in. Therefore, I think we have extremely good grounds for thinking that we should succeed there in establishing the fact that Mr. Edison's patent in Germany and abroad will not prevent our manufacturing our lamps abroad, and, therefore, we are not infringers.

Mr. South (a shareholder) enquired if the amount of the shares in the Edison and Swan Company (£208,478) had been altered since this company united with the Edison Company? He noticed that there was a difference of £5 between the present and the previous balance sheet.

The Chairman: One share of £5 had been transferred back to our partners.

Mr. South: Is our liability on those shares the same as it was in 1884? Have we reduced that?

The Chairman: In last year's account we had £17,883 outstanding calls, which sum has been reduced now to £781.

Mr. South: What is our liability to the joint company?

The Chairman: The liability remains the same—£2 per share.

Mr. South: Have we any freehold property now?

The Chairman: No; that was taken over by the Edison Company when we fused our Benwell factory, that at Victoria, with stock in trade, &c., and they became the property of the Swan and Edison Company. We have got rid of Benwell factory and brought it to London. Outside the bargain was this foreign business; and that is an asset of the Swan Company in addition to the British Edison.

A Shareholder enquired whether the £3,000 put to the special reserve could not have been put to revenue instead of capital?

The Chairman: The object in leaving Lille is to reduce enormously the current expenditure; and you cannot reduce the

current expenditure without going through the operation of moving your plant; and that operation means sinking a certain amount of money in depreciation of plant, and the obligation we are under to get rid of all leaseholds there. We thought it was not necessary to carry the loss of that sort to the capital, as the object of it is to unburden revenue. If you do not do that, you must spend out of capital £800 or £900 a year. It is a sacrificing of income at once in order that you may spare income from year to year. We shall speedily overcome the loss in the removal of this business by a saving in annual expenditure. We should have liked to carry £3,000 to profit and loss; but I do not think it would be sound, or so much in the interest of the proprietors as the course we have taken,

A Shareholder: You are not entirely closing the Lille factory, as I understand?

The Chairman: No; we are diminishing its size.

Another Shareholder: I should like to ask whether the Edison Company is likely to make a call upon the Swan Company, because I suppose that would involve the making of another call upon your shareholders?

The Chairman: We happen to have the good fortune to be directors in the Edison and Swan also, and I think the proprietors of that company would be as reluctant to pay that call as you are; and even if a call *were* necessary, you will see that we have, as far as you are concerned, money in hand to meet it. We have a liquid asset—sundry debtors, £8,588; stock on hand, £8,945; investment in Russian consols, £13,116; loan on mortgage, £14,300; investment in Consols, 3 per cent., £1,987; cash on deposit and in hand, £9,383; a total of £35,000 if it were necessary to apply it to that purpose. The Swan Company being proprietors of £208,000 in the capital of the Edison and Swan, are not liely to consent to a call being made unless they are thoroughly well satisfied that it is judicious to make such a call. Our interest in that concern is so preponderating that we are able to control such a matter. If a call were necessary, we should consult you; but we have the funds in hand to meet it. There is an uncalled liability upon your shares of £1 10s. We can easily pay another 10s. call on the Edison and Swan, without a call upon you. We have the money already.

A Shareholder: What is paid up of the £5 shares in the Edison and Swan?

The Chairman: £3. In reply to a further question the Chairman said: We began by making mistakes, as most young people do. We found, after bitter experience, that we could not go in for installations, and we paid a heavy price to get out of some. We are now content to manufacture lamps, knowing that in connection with all installations our lamps must be brought into requisition. The amount of money involved in lamp making is very limited indeed. There is no reasonable probability of any call being wanted, unless a development of this lighting business should involve a reversal of our present policy. If we were to see that, by some advance in science, or change of manner, there was a great profit to be derived from the installation business, we are quite free to take it up to-morrow. That, however, is not our present temper; we are willing to rest upon the lamp. "Prophets have no honour in their own country," and therefore I am going to give up that game.

Mr. Stearn: There are no profits here.

The Chairman: They are not the kind of profits I am alluding to.

A Shareholder: Is the law suit over? Is Rawson going to appeal again?

The Chairman: They have the power to appeal to the Lords, but one hardly knows what they will do. We have got our costs, and they will have to pay damages.

The Shareholder: How long have they in which to make up their minds whether they will appeal?

The Chairman: Twelve months.

Mr. Stevenson, M.P., congratulated the directors on the success of the anxious and difficult litigation which they had had in charge. It was satisfactory to know that they had got the legal position of the company into a satisfactory position. He thought it was to their interest not to go into installations, but to confine their attention to manufacturing lamps and getting money from royalties. In fact, he would suggest that they should seek profits from royalties rather than for manufacturing. If they, by an adequate, liberal system of royalties could get all the rest of the world to go into the manufacture of lamps, and contribute to them for the privilege of doing so, that might tend to getting the company into an easier position and a more profitable one than if they themselves attempted the manufacture and supply of all the lamps that were required.

The Chairman: It is a very material issue which we have to settle in our own minds, with due regard for the interests of the proprietors, as to what course we shall take under this litigation. Next to the quality of winning, I know of no better quality than that of using your victory discreetly. We are very much exercised at this moment to know exactly what we shall do. We are not relying upon our own judgment in this matter, because we have had not only the best legal advice in this country, but legal knowledge with great experience in practical matters—not merely technical legal knowledge. We are considering what will be best for ourselves, and also most generous to our adversaries if I may so term them. Mr. Stevenson has probably anticipated the course we shall take—trading with all mankind with royalties.

Mr. Stevenson, M.P., then proposed the re-election of Mr. J. S. Forbes, as chairman of the company, he having retired that day by rotation.

The motion having been duly seconded by a member of the board,

Mr. Leyland, in putting the motion, referred to the value of Mr. Forbes's services. The company was extremely indebted to him, not only for the amount of personal attention that he gave to its affairs, but for the great ability he had always shown in dealing with the various questions which came before him.

The motion was then put and carried.

The Chairman, in responding, said that being in a concern, he did not like to leave it when it was in trouble; when it had got alright he did not mind so much. Really, his value, he supposed, consisted in a natural aptitude to make the best of bad things. He thanked the shareholders for their renewed confidence in him, and trusted as the year went on they would meet with progress, and have next time they met a more palatable story to tell.

Mr. E. W. Batt was then re-elected a director, and Messrs. Quilter, Ball & Co. were also re-appointed auditors for the ensuing year, at a salary of 50 guineas.

The proceedings then ended.

India Rubber, Gutta Percha and Telegraph Works Company, Limited.

THE twenty-third annual general meeting of this company was held at the Cannon Street Hotel, on Tuesday, under the presidency of Mr. S. W. Silver, the Chairman.

Mr. W. J. Tyler, the Secretary, having read the notice convening the meeting,

The Chairman said he had very great pleasure in moving the adoption of the report, which contained, as he believed, a correct and a concise account of the company's operations for the past year. The results fully justified the dividend which the directors recommended, and this he considered a matter of congratulation. They were engaged in a commercial concern, and those who, like himself, were familiar with similar transactions were well aware of the hand-to-hand fight involved in the production of such a satisfactory result. In addition to this, they had to contend with the adverse price of raw material, which was not met by a proportionate return in the sale. Of the 6 per cent. debentures, £100,000 had been paid off, and debentures to the amount of £200,000 had been issued at 4½ per cent. The additional capital had enabled them to reduce their liabilities substantially. As regards cables, their operations during the year had included the laying of 2,000 miles. This had been very successfully carried out, considering the unusual number of separate landing places. The construction of the *Buccaneer*, which had been purchased for the purpose of this work, rendered her specially adapted for the in-shore work of such expeditions as the West African. Electric lighting was a subject which was attracting a great deal of public attention, and he was pleased to inform them that their works were lighted on a large scale. The experiment had proved a complete success. They had a better light at a lower cost than formerly, and the workmen found the atmospheric conditions under which they had to work very much improved—they had better air to breathe and a better temperature to work in. The vessels had been actively employed during a considerable portion of the year in the West Indian waters and on the West Coast of Africa. Their works were in a complete and efficient condition, and they were capable of undertaking the most extensive contracts they could secure on the shortest notice. He thought he ought to express, in the names of the shareholders, their thanks to the staff and the officials under their direction for their attention, and more especially to Mr. Matthew Gray and the others with him who had carried out the work on the West African coast so efficiently. In conclusion, he moved "That the directors' report and accounts now presented be received and adopted, and that a dividend of £1 per share, free of income tax, payable on and after the 23rd inst., be and is now declared."

Mr. Neil Bannatyne seconded the motion.

Mr. E. D. Sweet asked for an explanation with regard to the income tax, which last year seemed to have been paid upon the gross profits and not upon the net.

Mr. Payne said the question of income tax having been raised, it might not be inappropriate to ask if the £4,000 paid to the directors was paid in addition to the income tax. He also suggested that, the times being so bad, the directors might consider whether they would not take less than the £4,000 a year. He did not for a moment hint that their fee should be cut down against their wish, but a little spontaneous movement of the kind on the part of the directors would be appreciated by the shareholders.

Mr. Burt enquired as to the prospects of the sale of the works in France.

The Chairman, replying upon the points raised, said the income tax was paid upon the net profits, but the Government allowed no deduction for depreciation, and therefore the amount upon which tax was paid was larger than what appeared as net profits in the balance sheet. This was rather a complicated matter, but Mr. Sweet might see the returns if he called at the office of the company. In answer to Mr. Payne, they had gone through years when the shareholders had nothing, and the directors then took nothing. That fact, he thought, would be an assurance to the shareholders that when a lower dividend than 15 per cent. was paid the matter of lower fees would be taken into consideration. With regard to the French works, they remained *in statu quo*. They had had no offers with reference to them since the last meeting.

The motion was then put and carried unanimously.

The Chairman moved the re-election of Mr. Scott as a director.

Mr. Bannatyne seconded, and the motion was carried.

Dr. Small moved, and Mr. Disey seconded, the re-appointment of Mr. John Weiss as auditor, which was agreed to.

Dr. Small proposed a vote of thanks to the directors and officials of the company for the manner in which the business of the company had been conducted.

Mr. Teble seconded, and the vote was cordially passed, Mr. Silver suitably responding.

Telegraph Construction and Maintenance Company, Limited.

THE report of the directors states that the accounts for the year show a net profit of £75,651 0s. 0d. after charging the interest on the debentures. To this sum must be added £65,267 4s. 3d. brought forward from last year, making a total of £140,918 4s. 3d. From this amount is deducted the interim dividend of 5 per cent., paid July 20th, 1886, amounting to £22,410, leaving £118,508 4s. 3d. to be dealt with. Of this sum the directors propose to distribute a dividend of £1 16s. 0d. per share, absorbing £67,230, being at the rate of 15 per cent., and making, with the amount already paid, a total dividend for the year of £2 8s. 0d. per share, or 20 per cent., free of income tax, leaving £51,278 4s. 3d. to be carried forward to the next account.

The operations carried out during the year 1886 have been as follows:—

(*a*) A cable, 398 miles in length, was manufactured and laid for the Eastern Extension, &c., Telegraph Company between Penang and Singapore, the operation being completed early in June.

(*b*) A cable was manufactured for the African Direct Telegraph Company, and in July two of the company's ships left England with sections of it to connect the Colonies of Bathurst, Sierra Leone, and Accra. By September 19th the whole line was completed to Lagos and Bonny, the total length being 2,078 miles, part of which was made in the year 1885.

(*c*) Various lengths of cable amounting to 832 miles, were manufactured during the year for several telegraph companies and Foreign and Colonial Goverments.

The company's steamships, and the factories at East Greenwich and Wharf Road are in efficient working order.

The Maxim-Weston Electric Company, Limited.—The directors recommend a dividend of 5 per cent. for the past year, leaving a sum of £164 1s. 10½d. to be carried forward. The report further states that during the year 50,000 shares were issued to the shareholders at par, which were then selling at a large premium, equivalent with the dividend recommended to 10 per cent. on the capital of the company issued to date.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th February are £2,925, as compared with £2,600 in the corresponding period of 1886.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 18th were £2,822 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending February 18th amounted to £3,481.

NEW PATENTS—1887.

2079. "Controlling telephonic communications." J. GILL. Dated February 10. (*Complete.*)

2086. "Measuring, recording, or indicating currents of electricity." T. PARKER. Dated February 10.

2117. "Thermopiles." G. E. DORMAN. Dated February 10.

2122. "Electric motors." R. E. B. CROMPTON, J. H. F. SOLL. Dated February 10.

2128. "Printing instruments for the receiving instruments of telegraphs." F. H. W. HIGGINS. Dated February 10.

2130. "Electrical inductors and commutators therefor." F. JEHL. Dated February 10.

2134. "Galvanic batteries." A. SCHANSCHIEFF. Dated February 10.

2191. "Electro-magnetic motors." H. H. LAKE. (Communicated by J. Audouy.) Dated February 11.

2195. "Decorating articles of furniture and tables electrically; appliances therefor." F. H. JUDSON. Dated February 11.

2206. "Diaphragms of electrical telephones." J. S. ROSS. Dated February 12.

2222. "Electric sewing machines." T. H. WILLIAMS. Dated February 12.

2251. "Tubes or conduits for electric conductors." J. H. JOHNSON. (Communicated by A. Léon.) Dated February 12. (*Complete.*)

2377. "Electro-magnetic brake systems." G. F. CARD. Dated February 15. (*Complete.*)

2390. "Electrolytical treatment of ores for extraction and recovery therefrom of gold, silver or copper; apparatus therefor." H. LIEPMANN. Dated February 15.

2419. "Dynamo-electric machines." F. BOSSHARDT. (Communicated by A. L. Hillaire-Desbois.) Dated February 16.

2451. "Distributing electricity with alternating currents." O. T. BLATHY. Dated February 16. (*Complete.*)

2481. "Galvanic batteries and electric connectors for other purposes." R. MARSH. Dated February 17.

2502. "Switches for electric lighting, &c." G. V. FOWLER, E. W. LANCASTER. Dated February 17.

2517. "Pipes or tubes for conveying telegraph wires, &c." D. WILSON. Dated February 17.

2546. "Electrical apparatus for restaurants, &c., for displaying bill of fare." A. W. HOSKING. Dated February 18.

2563. "Electrical primers." G. STUART. Dated February 18.

2567. "Junction box for electrical conductors." E. W. BECKINGSALE. Dated February 18.

2588. "Armature for electric motors." L. HANSON. Dated February 19.

2598. "Electric gas lighters." T. P. HEWITT. Dated February 19.

2602. "Producing aluminium and alloys of aluminium and copper by electro-deposition." C. A. BURGHARDT, W. J. TWINING. Dated February 19.

2614. "Incandescence lamp holders and switches." H. F. JOEL. Dated February 19.

2641. "Hydro-electric battery." G. W. RHODES. (Communicated by L. Lambotte.) Dated February 21.

2712. "Electrical mail indicator." H. J. ALLISON. (Communicated by A. F. Hochstadter.) Dated February 22. (*Complete.*)

2721. "Electric batteries." C. J. CURTIS, F. B. CROCKER, S. S. WHEELER. Dated February 22. (*Complete.*)

2765. "Transmitting gear for electric motors." J. Y. JOHNSON. (Communicated by W. H. Knight.) Dated February 22. (*Complete.*)

2815. "Condenser for the floors of electrified rooms." A. H. BYNG. Dated February 23.

2819. "Combining and arranging apparatus for operating electric lamps for signalling, &c." H. NEELINGER. Dated February 23.

2825. "Dynamo-electric machines." J. G. SLATTER. Dated February 23.

2835. "Electric batteries; putting same into and out of action." G. V. LAGARDE. Dated February 23. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

1877. "Improvements in electric lamps." N. TESLA. Dated February 9. 8d. An armature lever swings between the upper ends of the cores of these helices, and at the other ends of the cores are pole pieces between which is an armature that is connected to a tubular clamp around the upper carbon holder, and this tubular clamp is suspended from the aforesaid armature lever. The cores and pole pieces of said helices, the swinging armature lever and the armature of the clamp form a compound magnet. The electric current passes from the + binding post through the shunt helix of high resistance to the – binding post, also from the + binding post the current passes through the carbon holders and carbons to the main line helix, and a branch from this helix goes to the – binding post, and the end of said helix is connected to one of the pole pieces of the shunt magnet and is insulated. When the energy of the shunt core is increased by the increased resistance of the arc, the clamp is moved to allow the carbons to feed, and when the current through the shunt is abnormally strong, the armature of the clamp coming into contact with the pole of the shunt magnet closes a branch circuit, that allows the electric current to pass through the clamp and the branch and a part of the main helix to the negative binding post, so that the continuity of the circuit is preserved and the shunt magnet is not injured, and as soon as the carbons come into contact and a path for the current is re-established through them, the carbons are separated to form the arc. The ends of the swinging armature lever are curved, so also are the adjacent pole pieces of the respective cores, and the poles at the other ends of the cores converge to the faces that act upon the armature at the bottom of the tubular clamp, and there is a spring that tends to swing the armature clamp away from the aforesaid insulated pole pieces. The claims are 12 in number.

7028. "Improvements in primary electric batteries." G. F. ROSE. Dated May 25. 6d. Claims:—1. A primary battery consisting of any number of containers and porous vessels, one containing an acid solution of bichromate of potash and one set of electrodes, and the other containing water, and the other of the electrodes, substantially as described. 2. The battery described and illustrated by the accompanying drawings.

8608. "Improvements in electric safety lamps for use in mines." M. SETTLE. Dated July 1. 8d. Claims:—1. The use in electric safety lamps (of that class wherein the lamp is entirely surrounded by water) of a float so connected to a "contact breaker" that

upon the escape of the water the float falls and breaks the electric contact so as to extinguish the light, substantially as described and illustrated by the drawing. 2. The use in connection with the glasses of such lamps of an inner flange (or its equivalent) in absolute contact with both glasses, so that on the breakage of the outer glass, the inner glass becomes fractured also, and the water is admitted to the interior of the lamp so as to extinguish and cool the incandescent carbon, wire, or other light producing substance, substantially as described and illustrated by the drawings.

9042. "Improvements relating to electric incandescence lamps, and to the manufacture of illuminating conductors therefor." W. R. LAKE. (Communicated from abroad by A. Zanni, of Italy.) Dated July 10. 8d. Claims:—1. An electric lamp wherein two or more carbon rods or illuminating conductors are arranged in a globe or bulb, and are connected by one or more metal bars, or other conductors for the purpose specified. 2. In an electric incandescence lamp, the combination with two or more illuminating conductors of a mirror or reflector, substantially as and for the purpose set forth. 3. The improved electric lamp, constructed substantially as described with reference to either of the forms or modifications shown in the accompanying drawing. 4. The manufacture of illuminating conductors for electric incandescence lamps, by first forcing carbon paste through a perforated plate, and cutting the rods thus produced into pieces of the required length, then drying the said pieces, and subjecting them to a white heat in a crucible or retort, and then heating them in a solution of chloride of platinum and chloride of calcium, or other suitable solution, and again drying them, substantially as and for the purposes set forth.

9267. "Improvements in electric railways and in apparatus connected therewith." J. C. HENRY. Dated July 16. 8d. Has for its object: First. To control automatically along the line of an electric railway the supply of current to separate motor carrying vehicles whereby the current may be supplied to each motor in power proportioned to the work required, and the grades of the road, and also to afford a uniform speed of the motor. Second. To afford means for automatically reversing the poles of the motor and cutting out the resistance when from any cause an increment of speed in the motor occurs, and indicating the degree of speed. Third. To afford the proper means for the passage of the electric contacts or brushes along the conductors, and avoid switching said contacts. Fourth. To afford a re-inforce or quantity current to the overhead conductors, and the economical transportation of currents to long distances. Fifth. To support the motor upon the car in such a manner as to conform in movement to the car and its axle and in positive connection with both, and also to permit the motor to maintain a uniform speed irrespective of the speed of the car. Sixth. To provide means for supporting the wires to insulators by suspension, and also to provide means for supporting said insulators over the street also by suspension. Seventh. To provide means for automatically engaging and disengaging the variable speed gear on the motor vehicle. Eighth. To afford a series of horizontal contact wheels embracing the conductors. The claims are 19 in number.

9683. "Improvements in clutches for electric lamps." C. B. NOBLE and R. D. NOBLE. Dated July 27. 8d. Relates to an improved clutch for electric arc lamps, and it consists in certain features of construction and in combination of parts. The claims are 6 in number.

10217. "Improvements in electric telegraph keys." A. J. BOULT. (Communicated from abroad by R. A. Macready, of New York.) Dated August 10. 8d. Claims:—1. In a telegraphic key the combination of the tongue, the fixed knob on the end thereof, with a vertical opening through its centre adapted to receive the shank of the secondary knob, the platinum strip secured to the lower end of the said shank, the conductor connected with the said platinum strip, and the platinum points secured to the underside of the tongue on either side of the opening through which the shank passes, substantially as shown and described. 2. The combination with the operating tongue of a telegraphic key, the lever fulcrumed to said tongue, a portion of the lever extending beneath and parallel with said tongue and projecting beyond the end thereof, and a portion of the said lever extending above and parallel with said tongue; the rod secured to the underside of said lever; the weight secured to the lower end of the rod; the retracting spring secured to the said weight and encircling said rod, substantially as shown and described. 3. The combination with the tongue and lever of a telegraphic key, a detent or locking device connected with the lever and adapted to work in conjunction with corresponding means connected or integral with the tongue. 4. The combination with a telegraphic key, the binding nut having a projecting lip adapted to engage in close contact with the nut carrying the adjusting spring, substantially as shown and described. 5. The combination with a telegraphic key the retracting springs encircling the screws and resting in close contact with the adjusting nuts mounted on said screws, substantially as shown and described.

11694. "Improvements in electric lamps or lighting apparatus." H. H. Lake. (Communicated from abroad by J. I. Clapp, of America.) Dated September 14. 8d. Relates to electric lamps of that class in which the arc is maintained between the peripheries of two discs composed of carbon or other suitable material; and consists essentially in the means employed for separating the discs in order to establish the arc, and for subsequently rotating the discs in proportion as they turn away at their edges. The claims are 12 in number.

11863. "Improvements in electric arc lamps." J. SWINBURNE. Dated December 17, 1885. 8d. Claims:—1. The construction or arrangement and use of parts of arc lamps, so that the feed is regulated by the mutual repulsion of similar poles of electro-magnets, substantially as set forth. 2. The construction or arrangements and use in an arc lamp of a clutch or clutches, supported by a spring or springs, substantially as and for the purposes set forth. 3. The combination with or arrangement in an arc lamp of a double dash pot, substantially as described and for the purposes set forth. 4. The method of or arrangement of parts for electrically counterbalancing the loss of weight due to combustion of carbon, as set forth.

11950. "A new or improved auto-magnetic motor." E. DELABRE-FOURNIER. Dated September 20. 6d. Upon the two principle faces of a magnet, the inventor applies, in contact, two soft iron plates, dipped in a bath, acidulated either by azotic, chlorhydric, or other acid, both plates being covered, on the side facing the magnet, with a slight perforated coating of copper. By this arrangement of copper coatings and the dipping of the soft iron plates, the latter may easily be drawn away from contact with the magnet. When the contact of these two plates with the magnet takes place, the magnetic fluid of the multiple magnets is immediately interrupted, and the instant the plates are drawn away, the magnet recovers its attractive force. Consequently, it is evident that a to and fro motion may thus be easily obtained by using the attractive power of the magnet to attract an iron weight or piston, and then leaving the same to itself by breaking the magnetic current through the application of the two plates above mentioned. The claims are 3 in number.

12109. "An improved electrical drop indicator." R. PRICE. Dated September 23. 8d. The indicator drop is attached to a slotted quadrant, the curved slot being carried to a position beneath the fulcrum or pivot of the dial or indicator, where it is continued vertically for a short distance, according to the position of the coils of the electro-magnet. A tongue of metal extends below the quadrant to enable the indicator to be returned to its normal position, after a signal has been given. When the instrument is at rest, the vertical part of the slot in the quadrant is caught by a pin which is attached to the armature of the electro-magnet, and holds it securely locked against any disturbance from vibration or sudden shock, but, on the armature being attracted to the poles of the electro-magnet, the pin aforesaid is carried down to the curved part of the slot, and, by its own weight, the drop then falls to one side. The claims are 2 in number.

12169. "Improvements in dynamo-electric machines. G. C. FRICKER. Dated September 24. 6d. Claims:—1. The method of winding, substantially as described in reference to and illustrated in the accompanying drawings, wherein each coil is composed of two parts, the internal portion consisting of a channel shaped piece embracing the ring from the inside, and the external portion consisting of a rod or bar connecting contiguous channel pieces across the top part of the ring so as to form the ordinary "Gramme" circuit. 2. The method of constructing and holding in position the driving centre, substantially as herein described in reference to and illustrated in the accompanying drawings, wherein the cylindrical shell is cast in one piece with the driving arms, which latter project beyond the shell at each end, and are sunk in grooves prepared for their reception in the faces of suitable collars made fast to the shaft.

12617. "Improvements in automatic telegraphs." H. J. ALLISON. (Communicated from abroad by the "Writing Telegraph Company" of New York.) Dated October 5. 8d. The objects of my invention are first, to secure greater accuracy in the reproduction of the writing or matter traced by the stylus of the operator, so that the result may be, as nearly as possible, a fac-simile of the original matter traced; second, to secure greater speed; and third, to simplify the several parts of the apparatus. The claims are 19 in number.

13454. "A cap or cover for the ends of the revolving armatures of dynamo-electric machines." J. ROPER. Dated October 21. 6d. Claim: In connection with a dynamo-electric machine a cap or cover placed upon the end of the armature, the arms of which cap or cover are insulated from the wires of the commutator and of the armature, and the outer opening of which cap is closed by means of a disc of slate or other non-conducting material, all operating for the purpose, and constructed substantially in the manner described and represented in the drawings.

13741. "Improvements relating to mechanical telephone apparatus." H. H. LAKE. (Communicated from abroad by M. G. Farmer, of America.) Dated October 26. 8d. In this case the system may be conveniently regarded as comprising a main and branch lines. Communication between the terminals of the main line is effected in the ordinary manner, that is to say, a string or wire is connected to the diaphragm of the telephones, and stretched and suspended so as to take up the vibration produced in one and reproduce them in the diaphragm of the other. The other instruments are not permanently connected in operative relation with the main line, but means are provided for bringing one or more of them into such relation at any time, and in this feature the invention resides. The claims are 7 in number.

14098. "Improvements in means or apparatus employed in electric signalling between trains, and between trains and stations or other fixed points." O. HUGHES. Dated November 2. 11d.

Relates to improved means or apparatus employed in transmitting signals from a stationary or moving engine, or other vehicle, to a signal box, or any other station or fixed point, or to another stationary or moving engine or other vehicle, and *vice versâ*, while it is in the inter-signal section of a railway, that is to say, between the distant signals of two adjacent railway stations, or between any two points, provided with the necessary communicating means. The claims are 7 in number.

14493. "Improvements in electrical railways." E. E. RIES. Dated November 9. 1s. 3d. The object of the invention is to provide means whereby designated sections of the rails used as conductors may be automatically cut out of circuit under certain circumstances, and the circuit preserved by means of loops or shunts bridging such cut-out sections, and connecting the conductors which are severed from one or both ends thereof. The claims are 13 in number.

15462. "Improvements in the method of and apparatus for desiccating the insulating coverings of electrical apparatus." N. J. RAFFARD. Dated November 26. 6d. Claim:—Desiccation of the insulating coverings of electrical conductors, and of the various elements of electrical instruments and machines, as described, by submitting them to the action of a vacuum in suitable apparatus capable of being heated, substantially as specified.

15577. "Improvements in autographic telegraphs." H. J. ALLISON. (Communicated from abroad by the Writing Telegraph Company, of New York.) Dated November 30. 1s. 3d. Relates to that class of autographic telegraphs for which the inventor has heretofore filed several applications for letters patent in the United States. The object of the present invention is to improve the several parts of such an apparatus, so that it will operate with greater certainty, exactness and promptness. The claims are 34 in number.

CORRESPONDENCE.

The Theory of Self-Regulating Motors.

In reply to the "challenge" of Mr. F. J. Sprague (which we print in another column) Prof. Silvanus P. Thompson has addressed the following letter to the editor of the *Electrical World*:—"I have heard of a man who brought to a trotting match a fine high-stepping mare which had been entered in his name, when a curious incident arose. Some of the spectators, recognising the creature, pointed out that the individual who had entered the mare for the running had merely borrowed her for the occasion. Thereupon the individual in question without denying the fact offered to the bystanders (amongst whom were the owners of the animal) to bet a thousand dollars all round that she would lick creation for speed.

"I was reminded of this narrative by reading Lieut. Sprague's somewhat amusing challenge about the motors which appears in your issue of February 12th. As Lieut. Sprague, for whom I have the highest personal and professional regard, has done me the honour of mentioning my name in his 'challenge,' he will pardon my reference to the facts of the case. In 1882, a date at which Lieut. Sprague was, I believe, in England, Profs. Ayrton and Perry patented the regulation of motors by the process of using a *differential shunt and series winding*, they also enunciated in that year and the year following the mathematical theory of this kind of winding. That theory I expounded and developed in my work on dynamo-electric machinery published in August, 1884.

"In the *Electrical World* for October 16th, 1886, there appeared an extremely able, but anonymous, article on Lieut. Sprague's researches upon motors, which described a number of excellent forms of motor, and also entered into the theory of motor regulation. In this paper—and probably Lieut. Sprague can say whether the statement is true—it is stated that in the self-regulating forms of Sprague motors a differential shunt and series winding is also used. The article further gave a certain equation as 'the Sprague law of winding,' and that equation differs in no way, except in the mere symbols employed, from one of the equations (No. LIV.) given in my book. When I read this article, in justice to Profs. Ayrton and Perry I pointed out that the 'Sprague law of winding' was simply identical with the Ayrton and Perry law of winding. Profs. Ayrton and Perry also noted the point. So did my friend Mr. W. Mordey, whose experience and authority on motor matters are well known, and he poked a little quiet fun at Lieutenant Sprague, condoling with him on the misfortune that he had patented what was previously well known.

"What does Lieutenant Sprague do? I have read and re-read his letter. I do not find therein that he denies either that he uses a differential shunt and series winding, or that the theory of motor regulation by means of the differential shunt and series winding was given in 1882 by Ayrton and Perry. Does he deny either of these points? On the contrary, he poses with a high-flown theatrical challenge to all comers to build a motor that will equal the one that he will build, and he even names the umpires for the contest! That extravagant display of courage will not alter the facts. It is the facts that are the real issue, not the performance of the machine. Does Lieutenant Sprague wish to hide the real issue by inviting an expensive competition to try issues that are wholly irrelevant? His umpires can tell him at much less expense whether the Sprague law of winding is different from the Ayrton and Perry law of winding. Why, then, build the motors?

"I cannot speak either for Profs. Ayrton and Perry or for Mr. Mordey, but I greatly doubt whether they will accept a challenge on the wrong issue. What are the two umpires to decide? Which motor runs coolest? Which motor develops most horse-power per pound weight? Which motor has the highest economical efficiency? Which motor gives the best regulation under all sorts of loads? No man in his senses will enter into a competition before he knows what is the issue to be competed for. The real issue is indeed none of these things. It is not whether Lieutenant Sprague's motors are better designed than Mr. Mordey's, or whether they are better designed than those of Profs. Ayrton and Perry. The issue is this:—Has Lieutenant Sprague any right to claim or to use *the differential shunt and series winding* which was invented, described and claimed by Profs. Ayrton and Perry in 1882? Other issues are only secondary.

"Perhaps I do Lieutenant Sprague an injustice by concluding, on the strength of the anonymous article in the *Electrical World*, that he does claim or use this principle. If he does not claim or use it, there is an end of the matter: there is nothing left to contest. But if it is true that the Sprague mare has been borrowed from the Ayrton & Perry stable, then no amount of betting that she will lick all creation is of the smallest use: if she beats every other creature on the earth *that will not prove that she was not borrowed.*

"I regret much that Lieutenant Sprague's letter compels me to write so plainly, I remember well his earlier motors at the Philadelphia Exhibition—they were one of its best features. I congratulated him at the time on their ingenuity, and on their good design and performance. I congratulate him on the progress he has since made. I wish him fame and fortune. But I am not going to let him call Aryton and Perry's theory of self-regulating motors the Sprague theory, without protesting politely, but firmly, that it is not his.

"Silvanus P. Thompson.

"*February 21st*, 1887."

Electrical Fire Risks.

It is a pity that the Phœnix Fire Office should have such explicit faith in their rules for electric light installations; they will not in the future even take a hint from an experienced practical engineer, who certainly is the most likely person to know what is safe in electrical matters. They state that their rules are not the ones settled by committee, but those that were formed before the committee existed, and were then in their third edition. It is very satisfactory that they claim all credit of this third edition, which at that time

showed a great ignorance in electrical matters, and consisted mostly of trash, unpractical rules, and rules which did not in the least concern them. The present rules are a decided improvement, but "nothing to crow over," as there are many very important rules omitted; whether by accident or ignorance I am unable to say.

The Phœnix Fire Office have been very lenient, and the public have much to thank them for, but they will find from a longer experience that their knowledge of electrical fire risks is small.

Experimenta docet.

Sir Charles Bright's Presidential Address.

I notice in the report of Sir Charles Bright's address that he repeats a statement made on October 3rd, 1856, by Prof. Morse, that Messrs. Whitehouse & Bright had, in his presence, that morning telegraphed signals at the rate of 210—241 and, at one time, 270 per minute through subterranean wires laid in ten lengths from London to Manchester, but so connected together at their respective ends as to make a continuous length of 2,000 miles, the sending and receiving ends being in the Magnetic Company's office in Old Broad Street, London. Prof. Morse considered that these experiments had conclusively settled the question of "the practicability as well as the practicality of telegraphing through our proposed Atlantic cable. Since our experiments this morning settle the scientific and commercial points of our enterprise satisfactorily."

To persons acquainted with the subject, how startling this statement must have been, as it eclipsed all that had previously been done by Faraday, Latimer Clark, Whitehouse and others, for it meant that through 2,000 miles of a line, very faulty in insulation, with a copper resistance of not less than 51,600 ohms, signals equivalent to 18 words per minute had been sent and received in the form of dots on a Morse instrument. Surely the experience gained by Sir Charles Bright during the manufacture, laying, and working of the 1858 Atlantic cable should have convinced him of the fallacy of these experiments.

Since that unfortunate Atlantic cable, great and important improvements have been made in the manufacture, laying and working of submarine cables, but even at the present time, as far as I am aware, it is impossible to obtain as favourable results as were reported to have been obtained on the memorable occasion to which Sir Charles referred. I feel sure, therefore, that if he were to give his attention to the subject he would realise the true facts and discontinue the repetition of such statements, which, in my opinion, do great injustice to those gentlemen who have done so much to bring submarine telegraphy to its present state of proficiency.

There are several other points in Sir Charles Bright's address to which I might refer, but I fear I have already encroached too far on your valuable space.

Willoughby Smith.

February 22nd, 1887.

Underground v. Aerial Telegraph Lines.

Your article of February 18th on "Underground *v.* aerial telegraph lines," raises the question as to increased difficulty in transmission underground, by reason of the higher static capacity.

The inconvenience of working, amounting in many cases to absolute impossibility, when the wires are buried on existing plans is undeniable, but there certainly are means by which these difficulties, great though they be, may be overcome.

Two factors in the equation determining the capability of a line, whether aerial or underground, are the conductor resistance and inductive capacity. The working power can be increased by lowering either the one or the other.

No. 18 wire having C.R. of	24	ohms	×	·135	microfarad	=	3·24
„ 16 „ „ „	14	„	×	·135	„	=	1·89
„ 14 „ „ „	8½	„	×	·135	„	=	1·15
„ 13 „ „ „	6	„	×	·135	„	=	·81
„ 12 „ „ „	4½	„	×	·135	„	=	.61

to compare against an overhead No. 11 line which at its best has

R of 28 ohms per mile, I.C. ·0135 = ·38

so that for speed in working and practical capabilities

8½	No. 18	underground wire	=	one overhead No. 11 at its best.
5	„ 16	„		„
3	„ 14	„		„
$2\frac{1}{10}$	„ 13	„		„
$1\frac{6}{10}$	„ 12	„		„

It must also be borne in mind that the figure given, ·0135 microfarads per mile for an overhead line, is of one on the most favourable conditions, and is far from permanent in this unsettled climate of ours, whilst the underground capacity will be practically unchanged in any atmospheric conditions. It is not too much to expect that the figure taken as the best possible for underground, ·135 microfarads, will be reached in practice, seeing that all the telegraph factories in England are giving their attention to this.

It seems from the foregoing that it is simply a ques- of increased conductor to obtain equally good results overhead or underground, and it hardly appears fair to say that because a No. 18 wire buried produces results inferior to the No. 11 aerial, therefore underground work is impossible.

An objection may be raised to climbing round the difficulty in this manner, on the ground of greatly increased cost, but means can certainly be devised by which great economies can be made on the present cost of insulating and laying, and it may be economical to spend the money thus saved in heavier conductors.

Thus, if a

	Ohms.		Microfarads.	
No. 18 wire having a C.R. of	24	and an I.C. of ·230	will be	5·52
„ 16 „ „ „	14	× I.C. of ·230	=	3·22
„ 14 „ „ „	8½	× I.C. of ·230	=	1·95
„ 13 „ „ „	6	× I.C. of ·230	=	1·38
„ 12 „ „ „	4½	× I.C. of ·230	=	1·03

Or if a

No. 18 wire	is capable of transmitting	100	words
„ 16 „	„	175	„
„ 14 „	„	283	„
„ 13 „	„	400	„
„ 12 „	„	540	„

This is assuming that the inductive capacity will be kept at ·230 microfarads, the figure you give as the best obtained hitherto, but there is no reason why it should not be reduced very considerably. For the sake of argument, take the basis you name as possible, viz., ·135 microfarads per mile.

In the underground lines laid many years ago the copper used had relatively a high resistance, and the static capacity was also high. I, for one, am not prepared to admit that because those old lines did not prove satisfactory in working no advance has been made, or no means are now possible to provide for all the rapid transmission that may be wanted.

T. O. Callender.

Frosting Incandescent Lamp Bulbs.

I have for some time been trying to devise a plan for frosting or shading the bulbs of my lamps, so as to remove the intense brilliancy of the glowing filament when unprotected by a shade. I have, I think, hit upon a plan easy to apply and to remove, and costing almost less than nothing. I simply dip the bulb into a more or less saturated solution of saltpetre (I have no doubt there are many other salts equally good, or better), crystals of great beauty immediately form, more or less dense according to strength of solution, and the result is a frosted appearance, which adds to the look of the lamp, and does away with the annoyance complained of without unduly obscuring the light. In the case of pendant lamps, it is well to take the solution *to* the lamp, so as to avoid handling after it is crystallised.

J. T. Strange.

February 22nd, 1887.